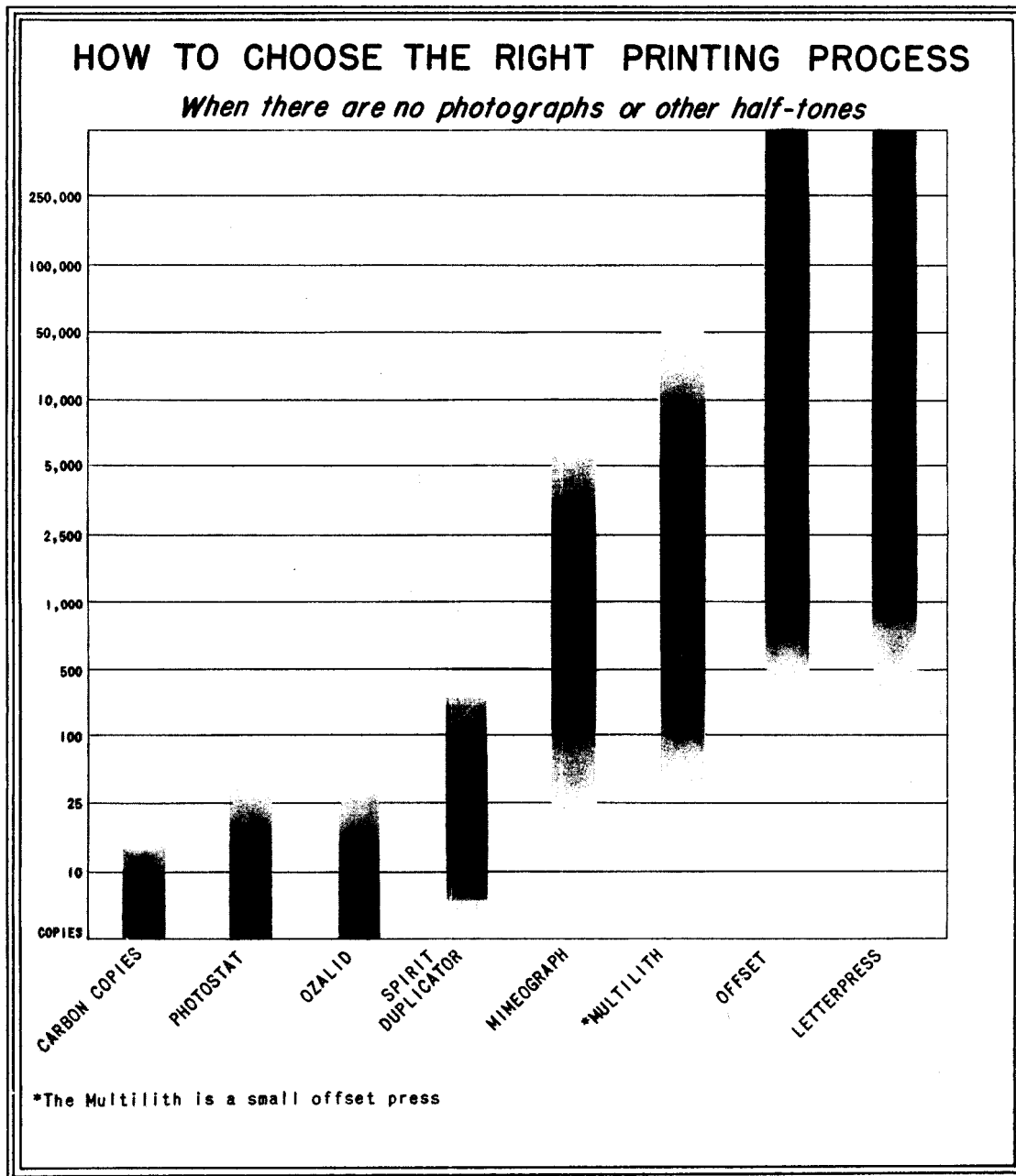


Printing & Reproduction
RETURN TO

RECORDS SERVICE
CENTRAL SERVICE

PRINTING AND REPRODUCTION HANDBOOK

September 1953



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*Printing
and
Reproduction
Handbook*

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Introduction

Presentation through graphics is as old as mankind. Pre-recorded history is related in a series of illustrations and hieroglyphic characters. Such recordings have had a twofold purpose: to communicate when verbal and sight methods were not adequate and for historical purposes.

The importance of these two purposes is more evident today than ever before. Witness the tremendous effort in research, man-hours, and money expended to develop new and better techniques and equipment. Such precepts have inflamed men's minds to action that has resulted in the wide and divergent fields that are now known as the graphic arts.

Graphic arts have been defined as the vivid expression of ideas through the media of an illustration or print. Obviously, there are many forms of graphic arts, of which one is printing and reproduction.

The field of printing and reproduction is often referred to as a technical and exact science. Visualize the commercial industry that has developed around facsimile or photographic reproduction. Then, too, review the tremendous business of the printing fields including intaglio, offset, and letterpress printing. The mere listing of chemicals used in the field necessitates a familiarity with the science of chemistry. Also, millions of dollars are spent annually in paper manufacturing.

This handbook, however, is compiled for the lay person who lacks technical background in the graphic arts. It is intended that it be used to show the different types of printing and reproduction processes available and to help in determining the particular process most applicable to a given situation. Three general methods are discussed; i.e., printing, photography, and bindery processes.

The mention of equipment by trade names in this handbook does not imply that such equipment is the only type available to do the job. Rather, it has been used for discussion of a type. Other manufacturers produce equipment that is competitive in every field. It does indicate, however, that by our use we think it good, dependable equipment.

Printing Methods

Printing is an omnibus word. There are many kinds of printing processes that tend to confuse the novice. The three general, basic kinds are relief printing, planographic printing, and intaglio printing. One example of relief printing is the ordinary letterpress printing. Offset, photo-offset, lithography, and multilith are examples of planographic printing. Intaglio printing is gravure, rotogravure, and engraved printing. Since intaglio printing is used on a limited scale, only relief and planographic printing will be discussed in this booklet.

Printing as a whole can be divided into two parts; (1) type composition and (2) the photo-mechanical method of printing. As herein used, printing will include spirit duplicating, stencil duplicating, offset printing, and letterpress printing. With the exception of improvement in materials and mechanical skills, these processes remain basically the same as when they were first discovered.

Spirit duplicating involves the dissolving of a carbon by means of alcohol and the resultant image being transferred to the paper. Ditto is an example of spirit duplicating.

Stencil duplicating is accomplished by centrifugally forcing ink through a porous tissue onto the paper. Mimeograph best describes this process.

Offset printing is the process in which the printing image and the nonprinting areas appear on a metal plate, both on the same plane or level. Lithography, photo-lithography, planographing, offset, and photo-offset are terms used interchangeably for the process most often referred to as offset printing.

In letterpress, a raised surface composed of type, cuts, etc., stands in "relief" above the surrounding area and this surface receives a coating of ink which is then pressed into the paper.

Related equipment used in the above processes will also be discussed in this section.

COMPOSING

Composing herein relates to copy preparation. An old axiom in the industry states that "no reproduction will be better than the original." Conversely, if the original is of poor quality, the printed copy will be of poor quality. The scope of composing, therefore, becomes of prime importance.

Most jobs have their inception in some sort of composing section. Generally, these sections are equipped with versatile equipment to produce good original copy. Typewriters, Vari-typers, Justowriters, and electromatic typewriters are a few of the machines that are most commonly used to produce original copy. Sometimes copy is set on a linotype machine and "reproduction proofs" are pulled to be used as original copy in the offset method of printing.

Another duty in copy preparation that belongs to the composing section is that of drafting. This covers all types of forms, charts, overlays, etc., and may include the use of handlettering or of a Leroy set. This original may then be used for visual reporting or as one to be reproduced by means of photography. Where photography is involved, the ideal original will be a high contrast between the black and white.

Of course, in letterpress where the character itself is inked, the character must be clear and sharp. Such flaws as broken or shaggy lines or nicked and uneven characters will be emphasized in the reproduction process. Blemishes and imperfections are most easily corrected on the original copy. Finger marks, smudges, etc., should be carefully avoided.

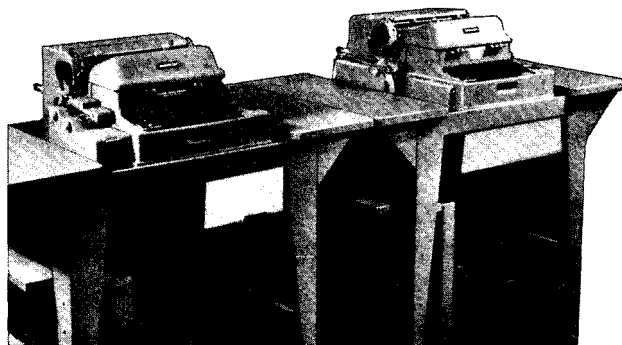
To eliminate expensive and time-consuming corrections, proofreading, editing, and format should be final before copy presentation is started. Dummy layouts should be made in the composing section. These assure correctness and alleviate extra work later in the processing.

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IBM PROPORTIONAL SPACER

Original : Copy Submitted
Result : Copy typed from once
used Paper Ribbon
Line : Justifies up to 9 in.
Manually
Approx. Price: \$600.00



JUSTOWRITER

Original : Copy Submitted
Result : Cuts Tape of Same
Line : Justifies up to 9'in.
Automatically
Approx. Price: \$5600.00

VARI - TYPER

Original : Copy Submitted
Result : Copy Typed from once
used Paper Ribbon
Advantages : Varied Type Faces
Line : 18 in. (Excellent
for Chart Work)
Approx. Price: \$955.00



SPIRIT DUPLICATOR

Ditto is a trade-mark of Ditto Incorporated. The ditto or spirit process of printing is basically a dissolving process whereby a carbon is dissolved and imprinted on a sheet of paper.

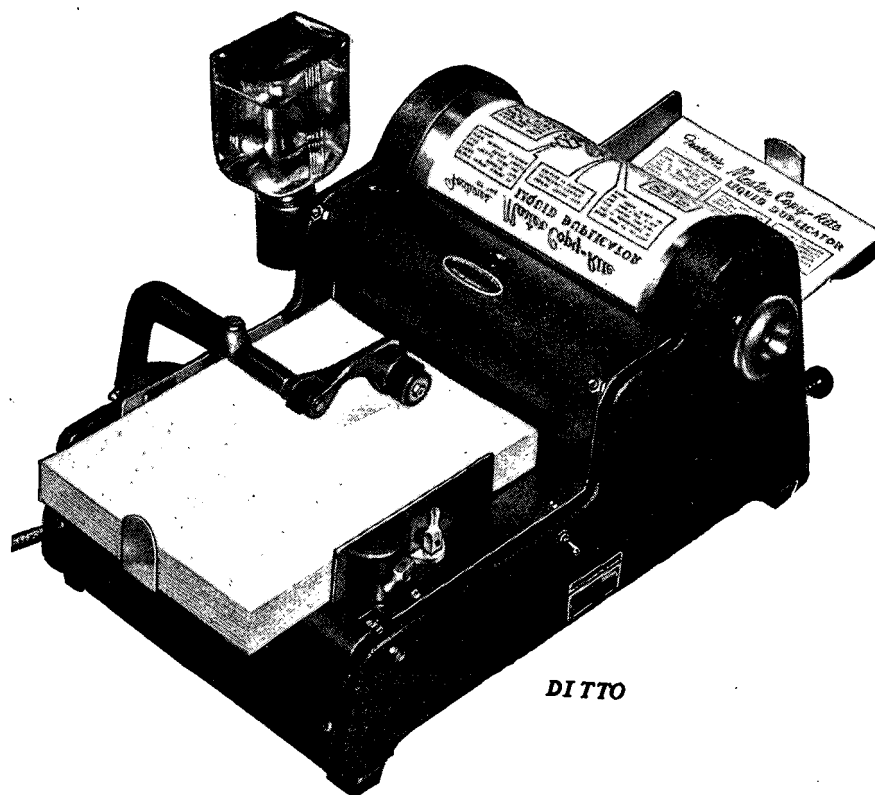
The ditto master is usually prepared by depositing carbon from a carbon sheet on the reverse side of the master. Since this can be accomplished with almost any instrument, this process is readily adaptable to sketches, charts, etc.; the typewriter is most often used, however, and corrections can easily be made. Any method of removing the carbon and redepositing it correctly will suffice. Uniformity in typing assures best results. Coated papers are used to improve the quality and to make ink additions easily.

Inasmuch as the carbon is quickly dissolved, the number of copies is limited. Usually a hundred copies can be expected with a gradual diminishing of quality thereafter. The process is slow with machine revolutions approximately 1,500 per hour.

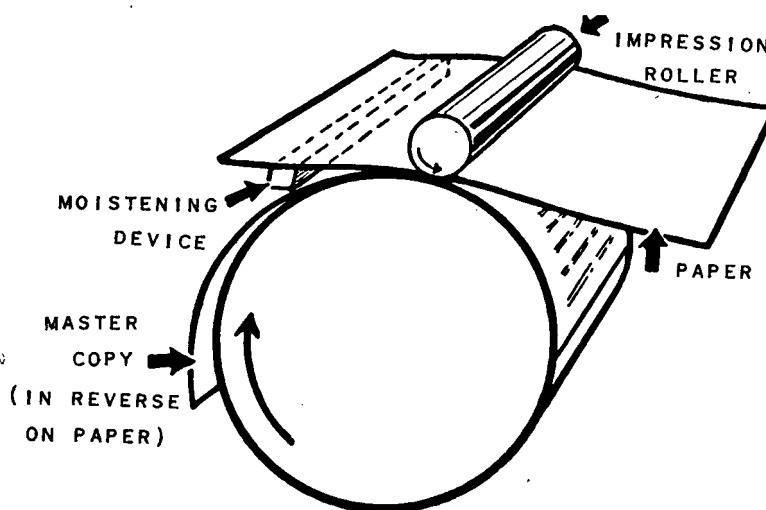
The finished sheet, usually in purple characters, and purple and white in appearance, is virtually impossible to use for future photographic processes.

Color work can be accomplished but with poor results, making this method a waste of both time and money for quality workmanship.

The process and the machine are relatively inexpensive.



DITTO



Original : Ditto Master
No. Copies : Up to 100
Revolutions : 1500 per hour
Sheet Size : $8\frac{1}{2} \times 14$
Printing Area: 8×13
Color : Very Poor
Rel. Cost : Inexpensive
Approx. Price: \$550.00

PRINCIPLE OF DITTO

STENCIL DUPLICATOR

Mimeograph is the trade-mark of the A. B. Dick Co.; however, its common usage has come to refer to the duplicating process rather than the company. Stencil duplicating is one of the most widely used of all office duplicating methods.

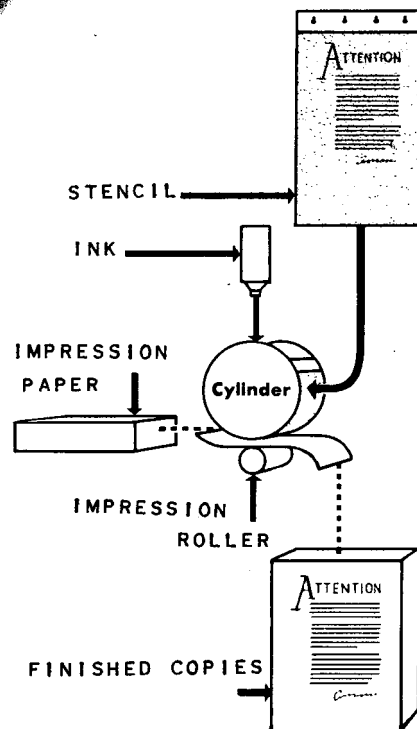
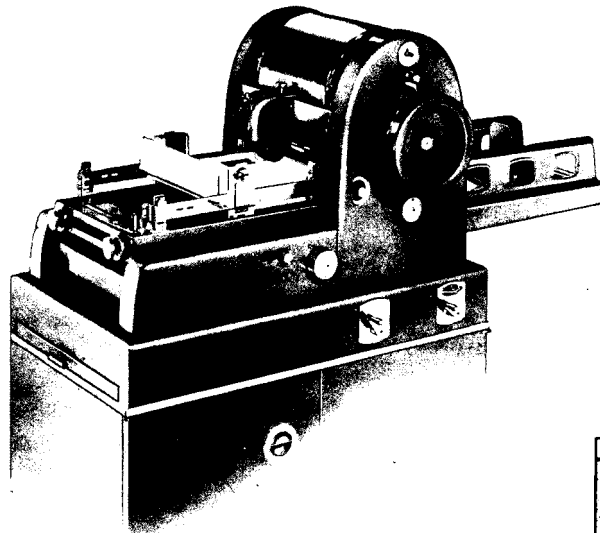
Mimeograph stencil sheets are made of a porous-base tissue covered with a coating that is impervious to ink. Typing or drawing on them with a sharp instrument pushes the coating aside and exposes the porous tissue. The stencil is wrapped around an inky cylinder and the cylinder is rolled across a piece of paper. Ink is centrifugally forced through the porous part of the stencil onto the paper, thus duplicating the message originally typed or drawn.

Effective stencil-duplicated work requires a good stencil, even ink distribution, and the right kind of paper. Mimeograph inks dry by absorption necessitating the use of absorbent paper. A good stencil is described as one having clear, sharp, even characters. Electromatic typewriters are used to obtain best results. Corrections are made easily by (1) burnishing the error gently using a circular motion, (2) covering the error with a thin coating of correction fluid and drying, and (3) retyping. Most stencils are pre-printed with instructions as to the length and depth of the lines that can readily be duplicated.

Colored inks can be used but the difficulty in changing from one ink to another makes this operation extremely uneconomical. Mimeograph is simple, quick, relatively inexpensive to produce and it can obtain up to 5000 copies for the life of the stencil at the rate of 4000 impressions an hour.

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MIMEOGRAPH



Original : Stencil
No. Copies : Up to 5000
Revolutions : 4000 per hr.
Sheet Size : 8 1/2 x 14
Printing Area : 7 1/2 x 13
Color : Very Poor
Rel. Cost : Inexpensive
Approx. Price: \$900.00

PRINCIPLE OF MIMEOGRAPH

CAMERA-LAYOUT

In processing an offset job, the original copy goes from the composing section to the camera-layout section. Here photographs are taken and negatives are made of the original copy. The camera is used for enlarging, reducing, same size copying, and color separation.

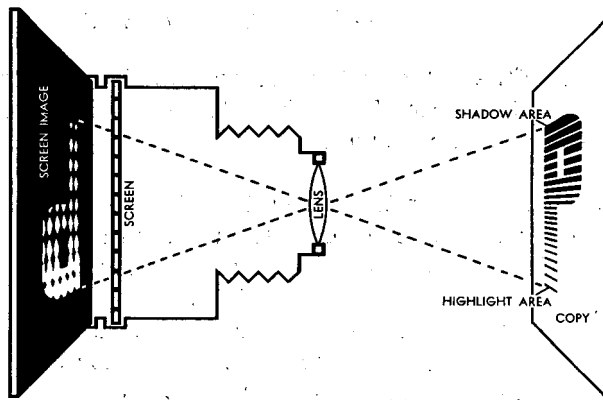
A negative must be made for every original. In color work where an overlay is prepared for each color, negatives must be made for each overlay. This is called flat color work and is used extensively in map reproduction.

In process color work where the original copy is in color, separation negatives must be made. By using filters on the camera, colors are sorted out. Generally, the work is done in four colors only -- black, yellow, blue, and red -- yet these are combined by means of the process-color technique to reproduce the browns, grays, greens, purples, oranges, etc. that will appear in the original. This process usually requires a certain amount of hand corrective work on the negatives. This is known as hand separation. There may also be additional cleaning to be done which is known as negative cutting. This is slow, tedious work and makes color separation very expensive.

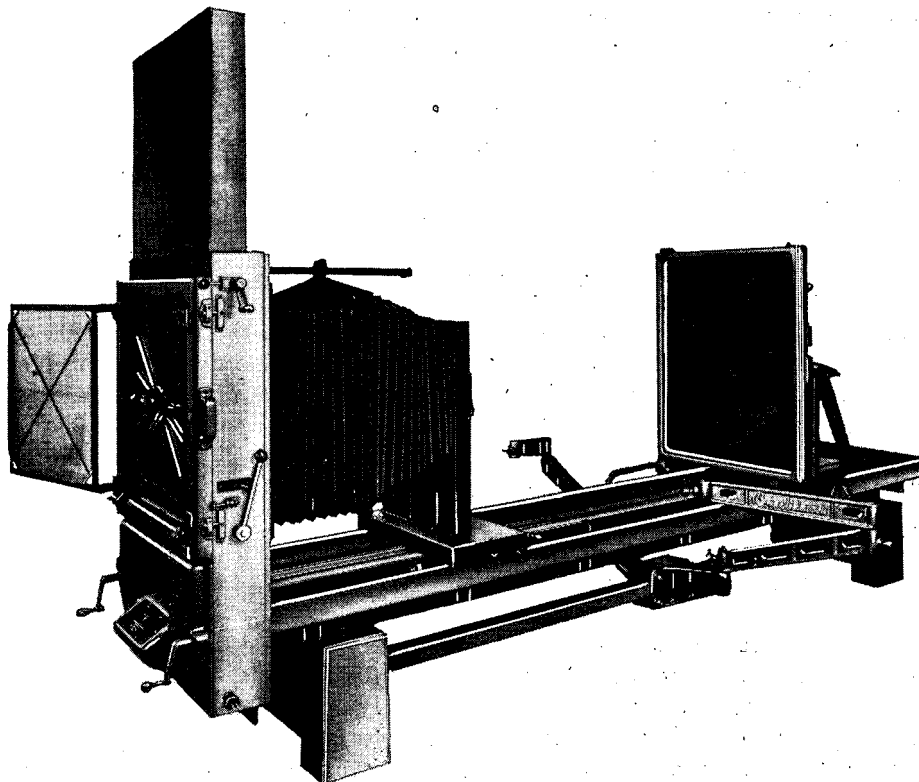
Any printing requiring the use of color injects the problem of "register." An example of poor register sometimes appears in the funny papers where a girl's lipstick appears misplaced on the chin or nose. Such conditions as negative stretch, or paper dimensional changes brought about by humidity change, accentuate the problem of register. Skilled technicians plus adequate working conditions combine to eliminate this problem which must be overcome for good color reproduction.

Since inks are solid colors and originals may vary, for example, white through gray to black, some method had to be developed to get black ink to appear gray when printed. This is accomplished by breaking the solid into fine dots by the use of a contact screen at the camera. Depending on the size of the dot or the relative white space to the printed area, any gradation can be developed. This is called halftone and is essential in the reproduction of photographs.

After all work necessary has been completed on the negatives, they are impositioned on a layout sheet. The image is bared and proper margins, paginations, etc. are calculated. This is called a "flat" and is necessary for the plate-making process. This flat also insures image position exactly as desired in the finished reproduction.



PRINCIPLE OF OFFSET CAMERA



Original : Copy Submitted
Result : Negative
Line Shot : 20 x 24 Film
Halftone : 20 x 20 Film
Other : Positives by Contact
Approx. Price: \$2700.00

OFFSET CAMERA

OFFSET PLATEMAKING

The goal in offset platemaking is to transfer the image from the negative or "flat" to a metal plate. There are two methods of preparing plates: one is known as the albumen process and the other as deep etch.

Since the albumen plate takes less time to prepare and will suffice for short runs, this process is more often used in the average print shop. The deep etch plate is more difficult to prepare but is advantageous for long runs.

To prepare an albumen metal plate, the plate must first be cleansed thoroughly with water and etched slightly with a weak acid. This is to remove all corrosion of the metal. The plate is then placed in a heated revolving machine (whirler) and coated with a light sensitive solution (egg albumen solution, ammonium dichromate, and water). The revolving action assures an even coating, and the heat dries the solution. The plate and "flat" are then placed in contact in a vacuum frame and exposed to an arc lamp. The rays from the arc lamp penetrate the clear areas of the negative and react chemically with the solution on the plate. After exposure, the latent image is perfected by "rubbing up" with a developing ink. The plate is then washed again and the unexposed areas wash clean, leaving an ink deposit on the desired image on the plate. The plate receives a coating of gum arabic preservative to stop oxidation and is then ready for the pressroom.

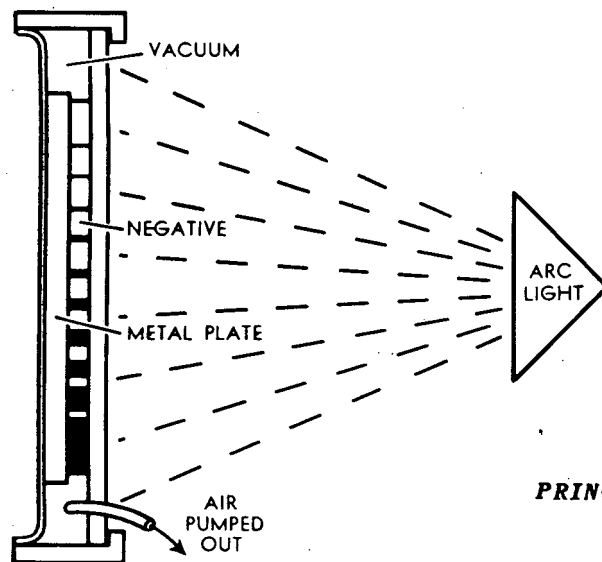
The deep etch process is much more complicated; some 30 different steps are involved. However, it is basically a matter of cleansing the plate with an acid and water and coating it with a deep etch coating solution (gum arabic, ammonium dichromate, ammonium hydroxide). The plate is then contacted with a film positive in a vacuum frame and exposed to an arc lamp. After an exposure has been made from the positive, the plate is developed with a "developer" which dissolves the unhardened coating out of the image areas. The developed plate is then etched with a solution which eats out the image areas. A lacquer is next applied over the etched areas to make them more receptive to greasy ink. After inking, the hardened gum coating is removed from the nonimage areas and the plate is ready for the press.

The so-called paper plates, or direct image plates, are new in the offset printing field. They were born of necessity as the industry has striven to speed up the process and to eliminate the costly operations of photography and platemaking. They are relatively inexpensive and can be prepared quickly. They generally are prepared with a typewriter using a special grease-base ribbon. Here again, the ultimate desire is to have a clear, sharp character. Disadvantages include poor quality, short life, and difficulty in making corrections.

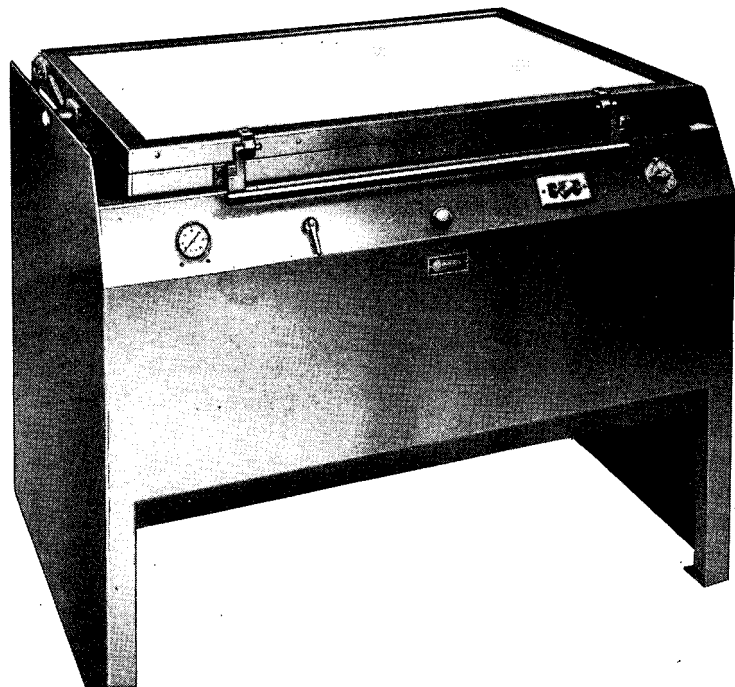
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PRINCIPLE OF PLATE PROCESS



Original . : Neg. or Pos. Flat
Result : Metal Press Plate
Methods : Albumen or Deep-etch
Approx. Price: \$350.00

PRINTING FRAME

OFFSET PRESS

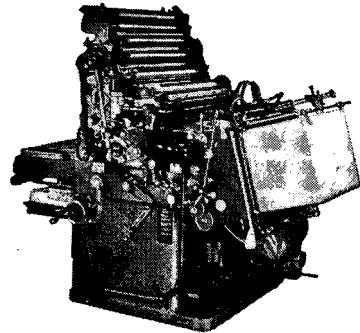
Aloys Senefelder, in attempting to produce music sheets cheaply, invented lithographic printing from stones. In 1818, he published his handbook on lithography in which he mentioned the possibility of using zinc plates instead of stone. It is interesting to note, although mentioned by Senefelder, that offset lithography or offset was not developed until almost 100 years afterward. The complete theory of offset printing rests on the mutual antipathy of water and grease and the disposition of greasy substances to adhere to each other. Preliminary steps such as the use of the camera and layout and the platemaking techniques are taken to prepare any image as a grease base so that it will have a mutual affinity to the greasy ink. Any offset printing press, regardless of size, is built around this physical principle.

Any press that implements this theory of offset printing is constructed basically with (1) an ink fountain, (2) a water fountain, (3) a plate cylinder, (4) a cylinder covered with a rubber printing blanket, and (5) an impression cylinder. In addition, a paper feeder and a delivery rack are essential. The complete offset printing press synchronizes all of these elements to get the image transferred or offset from the plate to the paper.

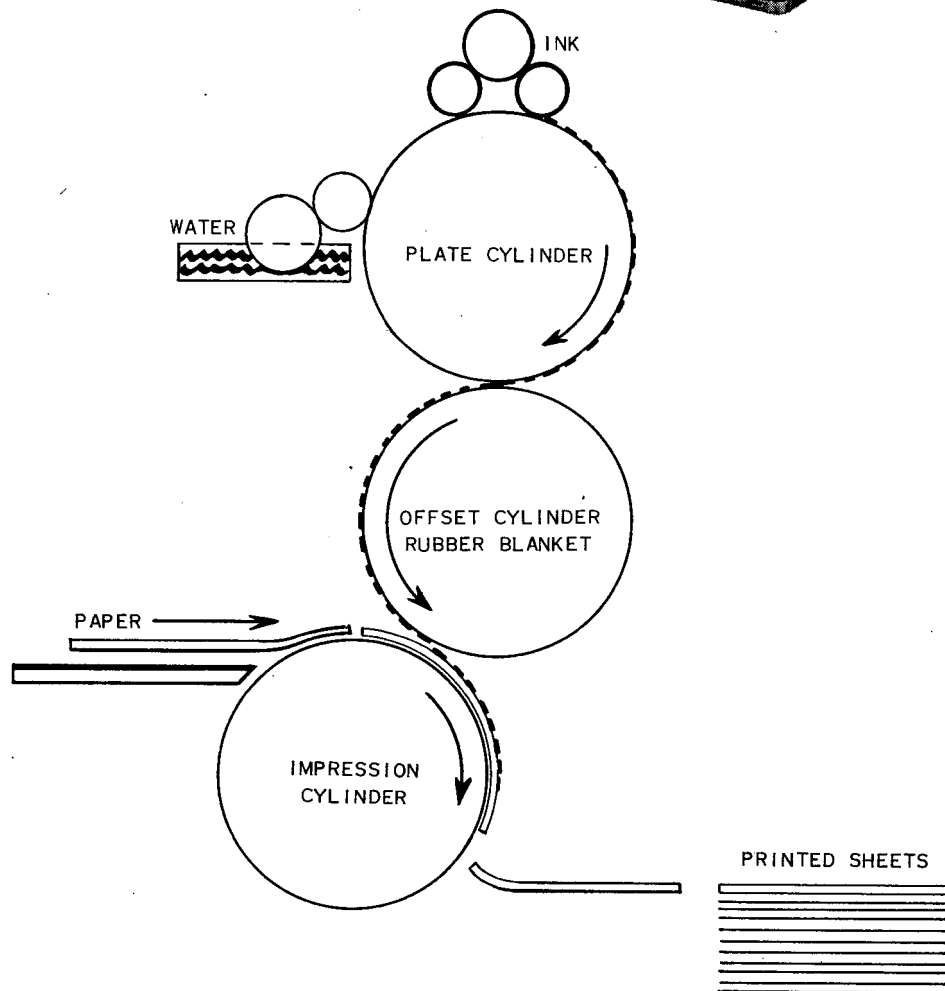
The plate, either paper or metal, is wrapped around the plate cylinder and securely fastened. As this cylinder revolves, the plate comes into contact with the rollers of the water fountain. Here the fountain solution or water completely covers the plate and adheres to the nonprinting area but not to the image area since the image is a grease base. The plate next comes into contact with the ink rollers of the ink fountain. The ink roller completely covers the plate, but remembering the basic theory, since ink is a grease base, it adheres only to the image area, also a grease base, and is repelled by the water in all the nonprinting areas. As the plate continues to revolve, it comes into contact with the cylinder blanket. The ink picked up by the plate from the ink roller is transferred to the rubber blanket of the blanket cylinder. The revolving of the blanket cylinder then deposits the ink onto the paper pressed against it by the impression cylinder. Thus, the ink is literally offset from the plate to the rubber blanket to the paper, the image on the plate never coming into direct contact with the paper itself.

In color printing, the press must be thoroughly cleaned and re-inked with each successive color that is used. The same sheet of paper has to travel through the press each time a different color is laid on. Thus every color has to be placed in exact relationship to every other color and in so doing the problem of "register" is introduced. This explains why all equipment must be so precise and why the operators must be skilled technicians.

Original : Metal Plate
No. Copies : Unlimited
Revolutions : 3 to 5000 per hr.
Sheet Size : 17 x 22
Printing Area: 16½ x 22
Color : Excellent
Rel. Cost : Expensive
Approx. Price: \$8000.00



OFFSET PRESS



PRINCIPLE OF OFFSET PRESS

LINOTYPE

Up to this point, the manual has attempted to explain the offset method of printing. This section introduces the direct or letterpress method. Here again the manuscript must be prepared so that it can be used on a letterpress to produce multiple copies. This is accomplished by hand (arranging foundry type) or by machine (linotype slugs).

The linotype is not a type setting machine. Instead, it composes with small brass units having characters indented in the edge. Each character is called a "matrix" and these matrices are assembled into a line by the use of a keyboard much the same as a typewriter keyboard. When the operator touches, say, the letter "L" a matrix for that letter drops into place in the line being set. When the line is complete, molten metal is forced against the matrices and the result is a linotype slug.

Two great problems were solved by the linotype machine in displacing the setting of type by hand. The first was the spacing between words so as to align the right margin (justify) and the second was the distribution of matrices back in their own compartments so as to be ready for re-use. The use of the space band, a wedge, solved the first problem and the second was solved by the application of the latchkey principle. Each matrix has a built-in key, like the key to a Yale lock, which will unlock the door to its own compartment and no other. The used matrices are automatically pushed, one by one, past each compartment in the magazine, but each can drop off the distributor bar only when over its own proper compartment.

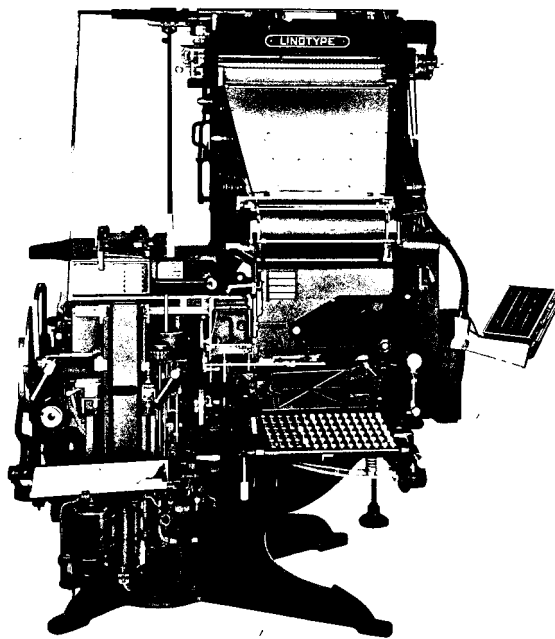
After the slugs are cast, they are hand-spaced into page forms and locked in a chase by compositors. They are then ready for the press.

The linotype is best suited for straight textual material. Tabular material is best set on a monotype machine. This machine casts an individual character at a time. It can be spaced as necessary to form the table.

Line cuts or halftone cuts must be prepared by the photoengraving process. This is accomplished by coating a metal plate, placing it in contact with a film positive, and exposing it. The nonprinting area is then etched down below the printing surface of the image and then routed by a routing machine. The metal plate is next mounted to a wooden block (type high) which is then locked in a chase and spaced or arranged with the type. It is now ready for the press.

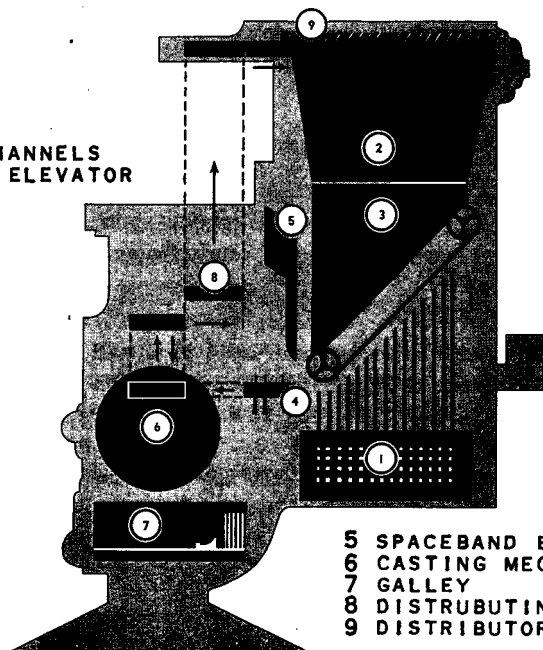
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Original : Manuscript
Result : Type Slugs
Avg. Speed : 4000 Ems per hr.
Approx. Price: \$10,000.00



LINOTYPE

1 KEYBOARD
2 MAGAZINE
3 DELIVERY CHANNELS
4 ASSEMBLING ELEVATOR



5 SPACEBAND BOX
6 CASTING MECHANISM
7 GALLEY
8 DISTRUBUTING ELEVATOR
9 DISTRIBUTOR

PRINCIPLE OF LINOTYPE

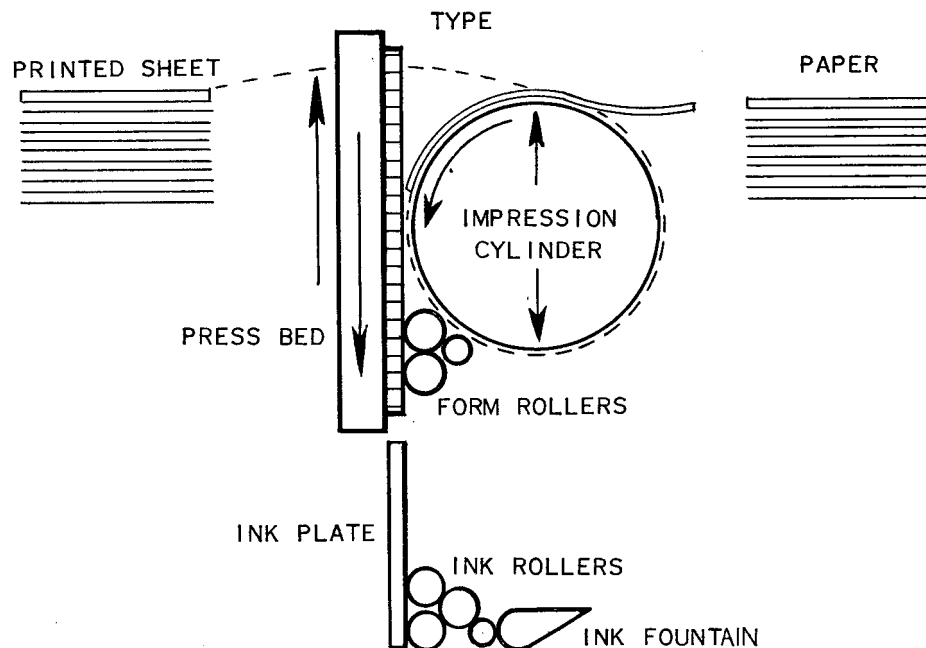
LETTERPRESS

Letterpress printing is the most commonly used form of printing as differentiated from offset, or gravure, etc. It is the oldest printing process and is used for practically all newspapers and a great many magazines and books. Letterpress printing is done on the relief principle whereby raised surfaces are inked and then pressed against the paper. This principle is utilized in two types of letterpresses; i.e., the platen press and the cylinder press. The platen press is one in which a flat surface bearing the paper is pressed against a flat surface bearing the inked type. The small hand presses are usually platen presses. The cylinder press has a cylinder bearing the paper which rolls over the inked type. It must make two revolutions for each impression, as during the second revolution no paper is fed, the cylinder lifting free of the type, and the type sliding back to its starting point. Some cylinder presses hold the type on a flat bed while some hold it vertically.

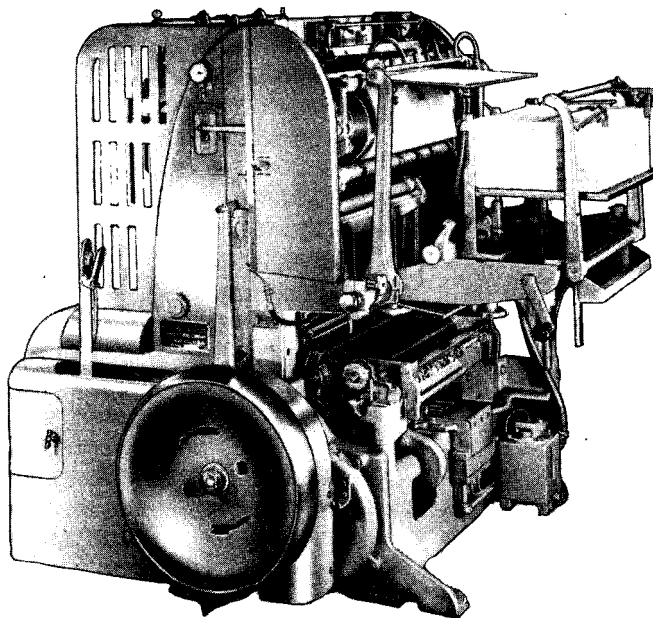
Rotary letterpresses should be mentioned since most newspaper work is done by this type of press. Rotary presses pass the paper between two cylinders, one of which holds curved printing plates while the second acts as an impression cylinder. These are the fastest presses manufactured.

Letterpress printing may be regarded as the norm against which to compare other processes. It gives sharper, cleaner reproduction of type than any other. It is always to be preferred when printing is to be done on glossy paper.

The letterpress printing process is capable of producing both very fine and very cheap results on either very short or very long runs. It is used for printing the highest quality photographic books as well as the daily newspaper. It can print with crisper and cleaner letters than any other method. It is unexcelled for photographs.



PRINCIPLE OF LETTERPRESS



LETTERPRESS

Original : Type Form
No. Copies : Unlimited
Revolutions : 3 to 5000 per hr.
Sheet Size : 14 x 20
Printing Area: 13 $\frac{1}{4}$ x 19 $\frac{1}{2}$
Color : Excellent
Rel. Cost : Expensive
Approx. Price: \$7065.00

S A M P L E

1. This is a sample of a ditto copy. The ditto master was put on an I.B.M. electromatic typewriter.
2. Number of copies ordinarily furnished: 25 to 100.
3. Type of work suited to the process:
 - a. Text and tables.
 - b. Line drawings.
4. Copy requirements: Master should be evenly typed with sufficient carbon deposits.
5. Size limitation:
 - a. Largest sheet - $8\frac{1}{2} \times 14$
 - b. Image size - 8×13
6. Color limitation: Colors depend on color of carbon used.
7. Quality of results:
 - a. Legibility - fair to good.
 - b. Writing surface - very good.
8. Approximate machine processing speed: 1500 per hour.
9. Approximate cost per print: .003.

S A M P L E

1. This is a sample of a mimeograph copy. The stencil was cut on an IBM electromatic typewriter.
2. Number of copies ordinarily furnished: 25 to 5000.
3. Type of work suited to the process:
 - a. Text and tables
 - b. Forms
4. Copy requirements: stencil should be cut with even, clear, sharp characters.
5. Size limitations:
 - a. Largest sheet - $8\frac{1}{2}$ x 11
 - b. Image size - $7\frac{1}{2}$ x 13
6. Color limitation: black on white.
7. Quality of results:
 - a. Legibility - good
 - b. Writing surface - poor.
8. Approximate machine processing speed: 4000 per hour.
9. Approximate cost per print: .002.

S A M P L E

1. This is a sample of offset printing (Multilith).
2. Number of copies ordinarily printed:
 - a. Paper plates: 50 - 500.
 - b. Metal plates: 100 - 10,000.
3. Type of work suited to process:
 - a. Text and tables.
 - b. Charts and graphs.
 - c. Photographic halftones (Larger presses).
 - d. Forms.
 - e. Drawings.
 - f. Color work (Larger presses).
4. Copy requirement: Clean, sharp, black characters on white paper.
5. Size limitation:
 - a. Largest sheet: 17 x 32
 - b. Image size: $16\frac{1}{2}$ x 22
6. Color limitation: Very good color reproduction.
7. Quality of results:
 - a. Legibility - very good.
 - b. Writing surface - very good.
8. Approximate machine processing speed: 3000 to 5000 per hour.
9. Approximate cost per page: \$5.00.

1. This is a sample of letterpress printing.
2. Number of copies ordinarily printed: 100 to 50,000.
3. Type of work suited to the process:
 - a. Text and small tables.
 - b. Forms.
 - c. Line cuts.
4. Copy requirements: Manuscript.
5. Size limitation:
 - a. Largest sheet: 14 x 20.
 - b. Image size: 13¼ x 19½.
6. Color limitation: Very good color reproduction.
7. Quality of results:
 - a. Legibility — very good.
 - b. Writing surface — very good.
 - c. Type selection — very good.
8. Approximate machine processing speed: 3,000 to 5,000 per hour.
9. Approximate cost per page: \$6.00.

Photographic Methods

In recent years, photography has played an increasingly important role in human progress. Documentary reproduction is one of the most important phases of modern photographic activity. It is not primarily concerned with photography as an art but as a science. The aim of photographic reproduction is to achieve an accurate representation of the original. The modern concept of an original document assumes many formats, such as photographs, drawings, paintings, books, manuscripts, magazines, tracings, etc. A startling example of photo-documentation may be found in popular picture magazines which utilize a minimum of words and depends on photography to tell the story.

The essentials for photographic reproduction are surprisingly few: an original, camera, sensitive material, light, methods for processing and printing, and sufficient knowledge to combine them in order to produce the desired result. The tremendous quantity and variety of commercially available equipment and supplies attest to the thorough coverage by the industry.

It is not intended here to go into the scientific facets of photography such as light, cameras, lenses, filters, papers, and chemicals but instead to explain representative processes that provide a fairly complete coverage to meet nearly all photographic reproduction requirements.

It is evident that no one particular piece of equipment or process provides the solution to all photographic problems. Physical and scientific limitations require the use of special and complex equipment and supplies. This explains the large commercial photographic field:

16 AND 35 Mm. CAMERAS

This branch of photography deals with very small film images and is known as microphotography. Film sizes, 100 feet in length, of 16 and 35 mm. are commonly known as microfilm and cameras utilizing these films are known as microfilm cameras. However, regardless of size, their operation is basically the same. Each has a light-tight housing for the raw stock, a lens and shutter for controlling light rays, a copy board for holding the material to be photographed, and a light source for illumination. All cameras are adjustable in order to make necessary reductions.

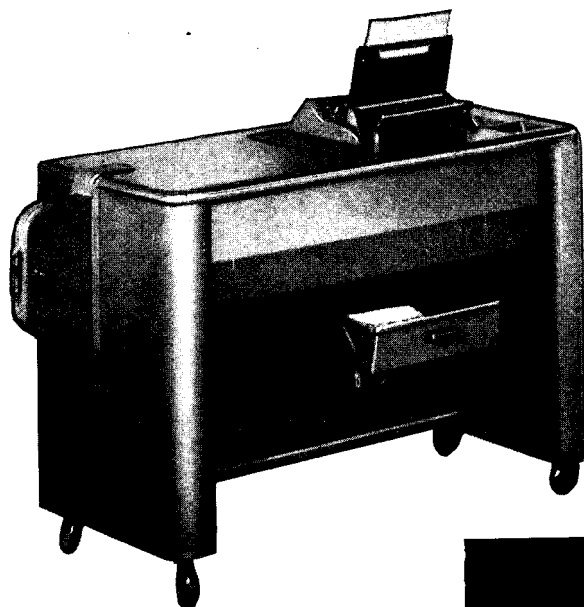
The actual operation of these cameras is not difficult. The material is placed on the copy board and is held there with a large plate glass. The copy is illuminated and a light meter is used to determine the correct exposure. The camera head is then raised or lowered to establish the proper reduction. Exposure time is established and the shutter is opened and closed forming the image on the film in the camera housing. The film is then advanced one frame and the process is repeated.

After the entire roll of film has been exposed, it is taken from the camera into a dark room for processing.

Microfilming is rapid and comparatively inexpensive. Such tasks as removing and replacing staples or paper clips, folding and unfolding maps and charts, repeated raising and lowering of the camera head to adjust for various-size papers, are very time-consuming and increase costs. This, apparently negligible set of procedures, is one of the biggest problems facing microfilmmers today.

The microfilm industry has enjoyed great expansion during the last decade. Its greatest utilization comes in storing film instead of originals, thereby affecting tremendous savings in storage space. Transportation costs are greatly reduced and the film can be made available to different localities quickly and easily.

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16 MILLIMETER CAMERA



35 MILLIMETER CAMERA

Original : Copy Submitted
Max. Orig. Size: Up to 36 x 48 in.
Result : Duplication on 16
or 35 mm. Film
Approx. Price : \$1500.00

MICROFILM PROCESSING

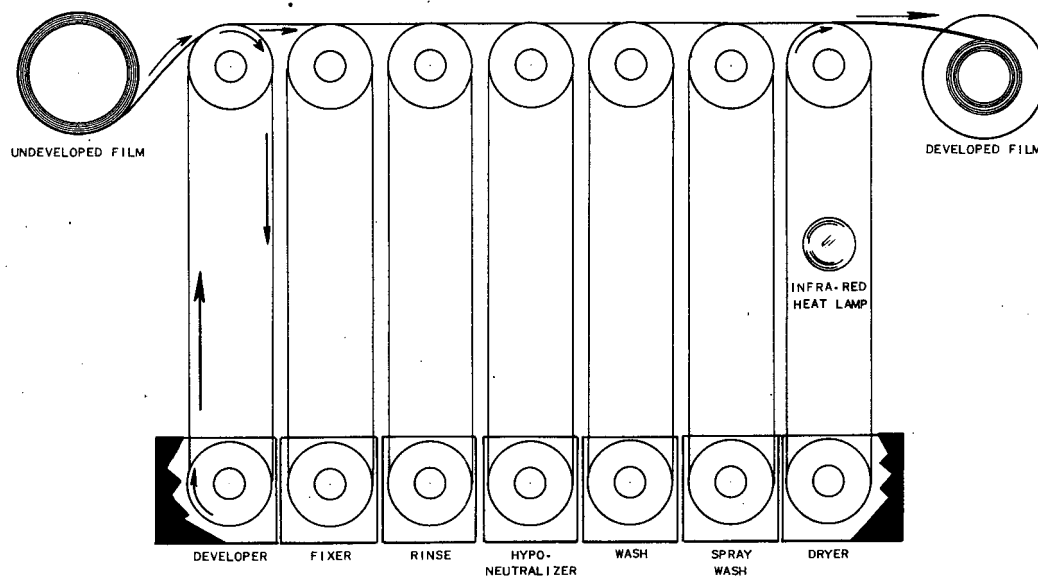
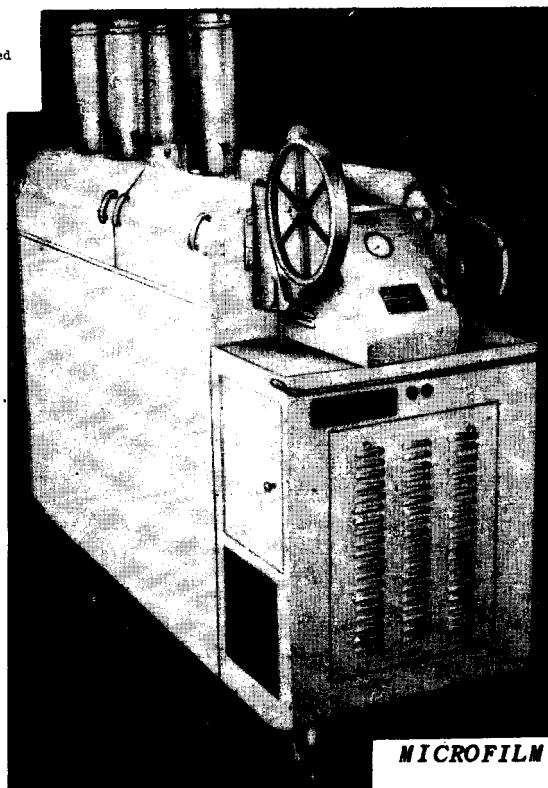
The type of equipment used in processing microfilm is usually determined by the quantity to be processed. The strict amateur processing the 20 or 36 frame rolls will employ equipment such as the Steinman reel. This light-tight box with concentric partitions is simply a developing tank. Fixing baths and washing containers have to be provided elsewhere.

A small microfilm processing laboratory will probably utilize deep tanks when processing 100-foot rolls or less. These are a series of wooden or metal tanks about 8 inches wide by 36 inches long by 40 inches deep. Each tank contains a different chemical solution: first, the developer; second, the short stop or developer neutralizer; third, the hypo; and fourth, the water for washing the film. A rack is constructed that will fit down into the deep tank. Rolls of film 100 feet in length are wound around this rack and placed into each tank successively as the processing proceeds. A photographer constantly agitates, inspects, and times the film through each of the tanks. Such a system of processing by these tanks necessitates manipulation in a darkroom. Film can be dried by hanging on a rack or the process may be speeded up by use of a revolving rack with the application of heat from infra-red lamps.

Concerns processing thousands of feet of microfilm will find the use of deep tanks too slow. They will invest in an automatic processor such as the Houston processor. This machine incorporates all the different chemical baths, washes, drying features. It is built on the flow principle in which the film constantly moves from one chemical solution to the next throughout total processing. Development time, fixing time, and washing time are all determined by the speed of the machine.

After microfilm has been processed, film duplicates can be made or the frames can be enlarged and paper prints made.

Original : Roll Film
Max. Film Size: 16 or 35 mm.
Result : Processes Exposed
 Roll of Film
Approx. Price : \$390.00



PRINCIPLE OF MICROFILM PROCESSOR

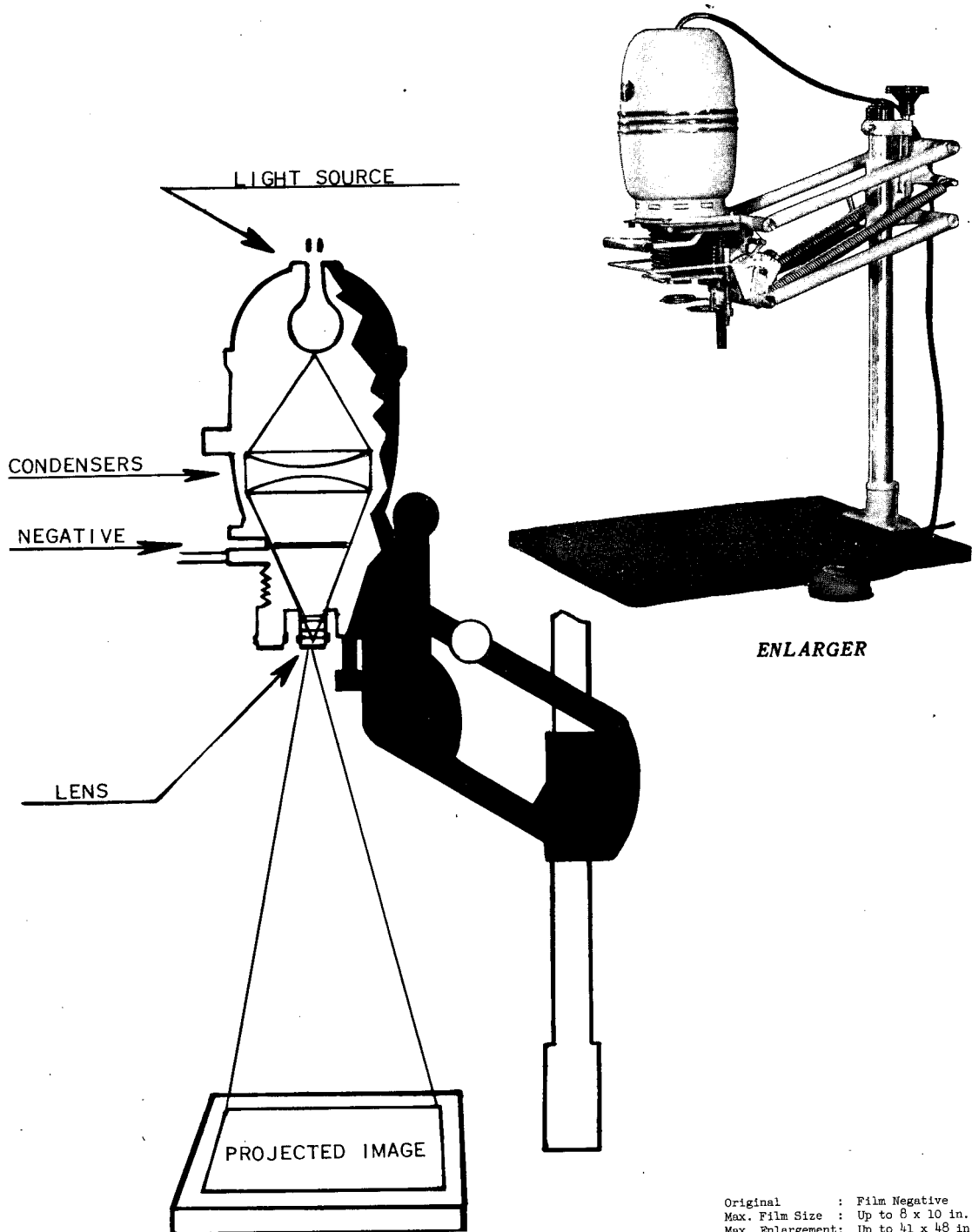
PHOTOGRAPHIC ENLARGER

A good enlarger, well designed and accurately made, is an important prerequisite for enlarging photographic prints of good quality. It is just as important as a good camera, both merely being links at the end of a chain of steps leading from the making of a photograph to the production of a finished print.

Basically, an enlargement differs from a contact print in that it is made by projecting a larger image of the negative onto a piece of sensitized paper. To do this requires that a light source be placed behind the negative to illuminate it and that a lens be mounted in front of the negative to project it. An enlarger therefore consists of a light source -- a means of illuminating the negative uniformly -- a negative carrier support, a lens and lens support with a bellows to shield the light rays, and a paper support or easel.

A good enlarger must be sturdily built and have a critically ground lens and an adequate illumination system. Enlargers may vary in size, but their operating principles are basically the same.

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PRINCIPLE OF AN ENLARGER

Original : Film Negative
Max. Film Size : Up to 8 x 10 in.
Max. Enlargement: Up to 41 x 48 in.
Result : Print of Quality
Equal to Negative
Approx. Price : \$425.00

MICROTRONIC ENLARGER

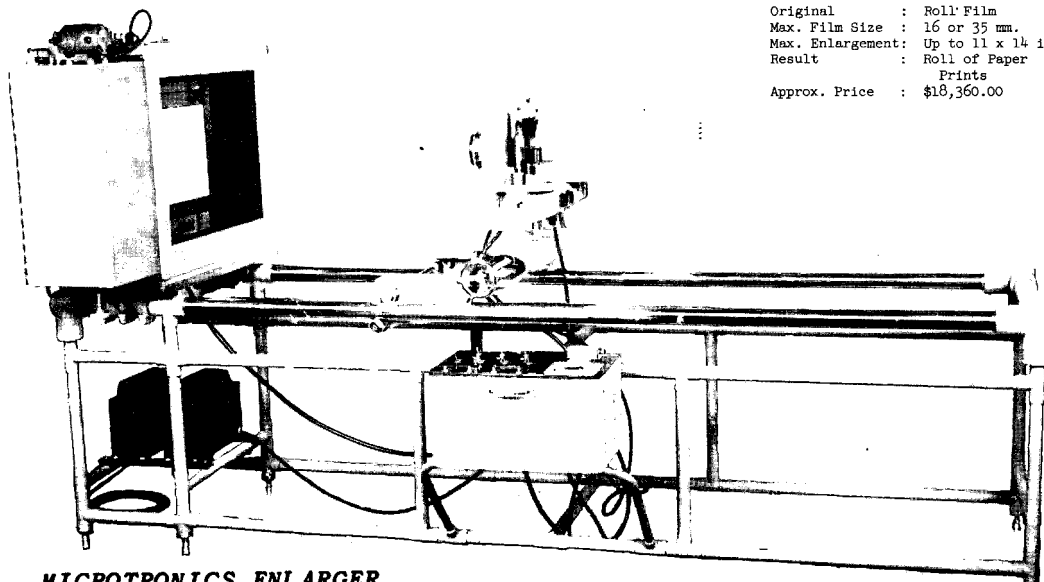
Over the years photographers and technicians in the graphic arts have attempted to speed up the process of providing a customer with a quality print. Photographic printing on roll paper is a result of this research. The collation problem is likewise greatly minimized by printing on roll paper. The microtronic enlarger has been developed to provide quality prints, quick processing, and fast collation.

The microtronic printer is an electrically controlled printer with an adjustable paper magazine twelve inches in height. It is for the projection of 16,35, and 70 mm. film. Rolls of paper 350 feet in length are used. It operates automatically advancing the film and paper simultaneously after the exposure has been made. Exposure is predetermined by taking density readings of the film. Film having an even density throughout, is quickly and easily printed; however, that which has wide density variations has to be printed manually.

The paper is contained in a light-tight housing until the roll is completely exposed. It is then ready for processing. A photographic technician is necessary to operate the machine.

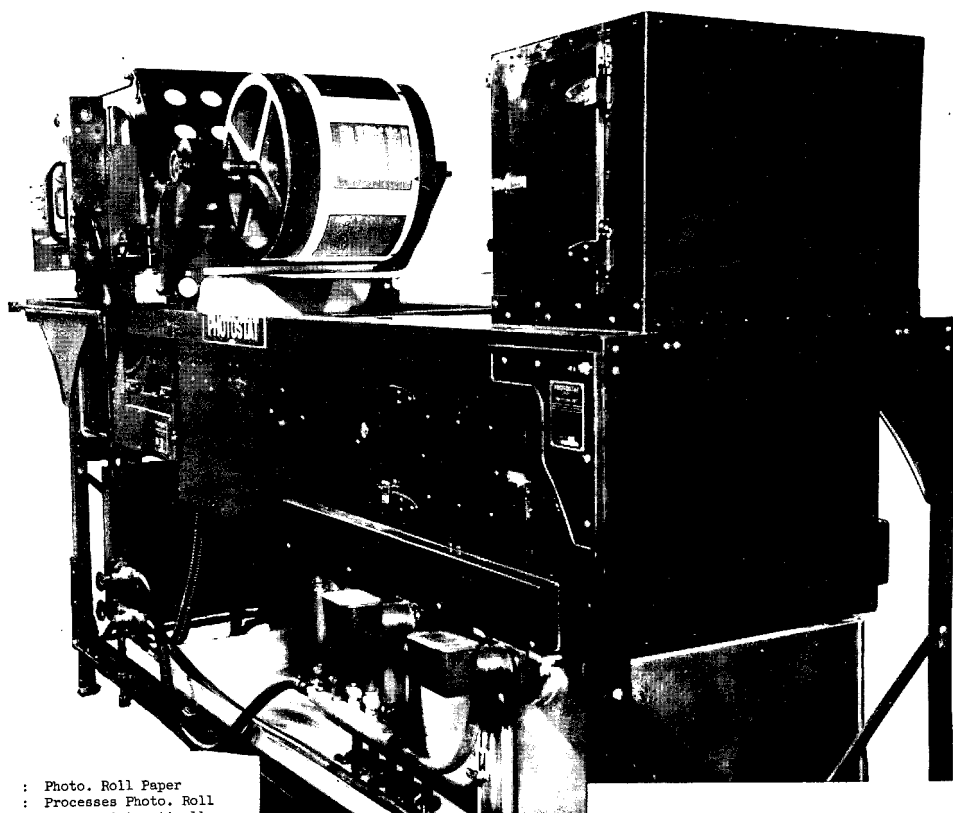
The exposed paper is processed in a processor adapted to handle roll paper. It is electrically driven and the paper progresses continuously through baths of developer, short stop, hypo, and water. After emerging, it is dried on a heat-revolving drum and rewound again into a roll. The speed of the machine is so calculated that it ensures proper developing, fixing, and washing times for the paper.

The rolls of paper are now ready to be cut into individual pages of printed material.



Original : Roll Film
Max. Film Size : 16 or 35 mm.
Max. Enlargement: Up to 11 x 14 in.
Result : Roll of Paper Prints
Approx. Price : \$18,360.00

MICROTRONICS ENLARGER



Original : Photo. Roll Paper
Result : Processes Photo. Roll
Paper Automatically
Approx. Price: \$8125.00

MICROTRONICS PROCESSOR

AUTOMATIC TRIMMER

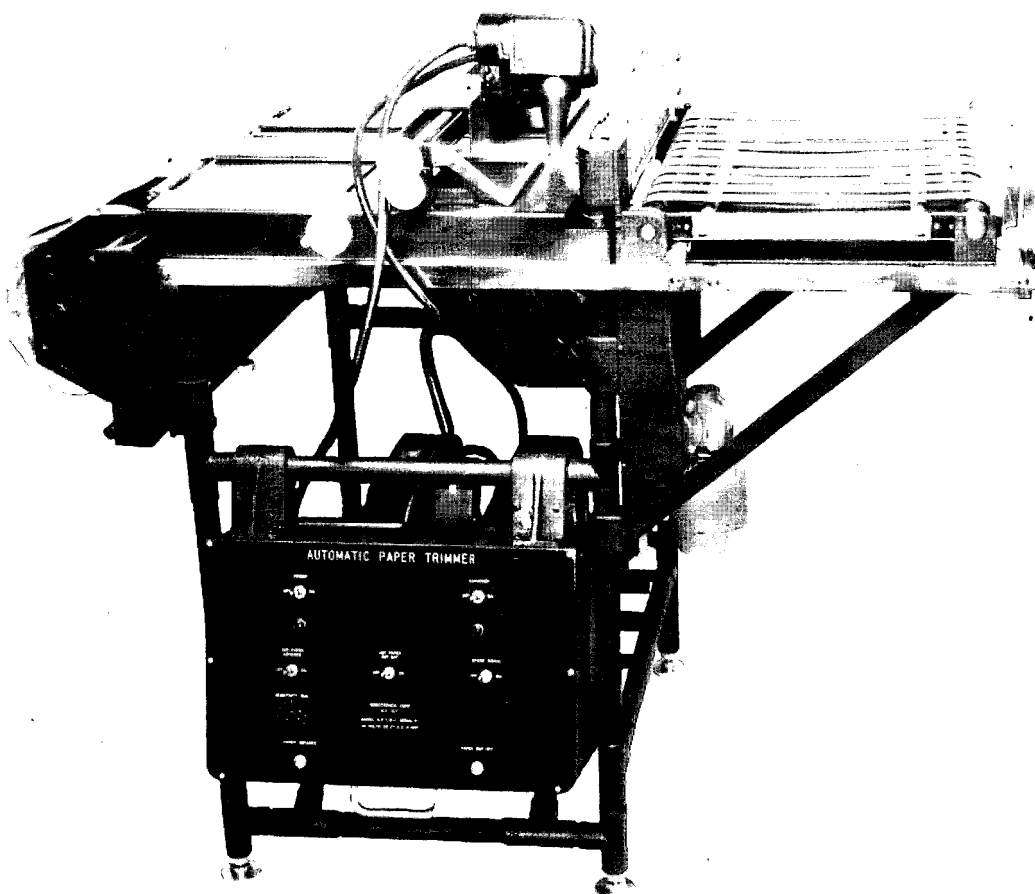
This equipment was developed as an integral unit in the processing of micro-film enlargements on roll paper. Quantity production of the microtronic enlargers preclude hand trimming of prints.

A photoelectric cell scans the edge of the paper as it travels through the machine. A strategically placed dark area on the paper activates the cell which in turn activates the knife blade causing it to cut the paper. The cut sheets pile up in a receiving tray collating the pages exactly as they were originally filmed. The length of the page is determined by the spacing between the dark areas that activate the photoelectric cell. The width of the page is determined by the width of the roll paper.

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36



TRIMMER

Original : Photo. Roll Paper
Max. Trim Size: Up to 11 x 14 in.
Result : Trims and Collates
Prints
Approx. Price : \$3867.00

OZAPHANE

Requirements often necessitate the rapid copying of microfilm for distribution to various recipients. After microfilm has been processed the easiest, speediest, and most economical method of making prints or duplicates is by the ozaphane process.

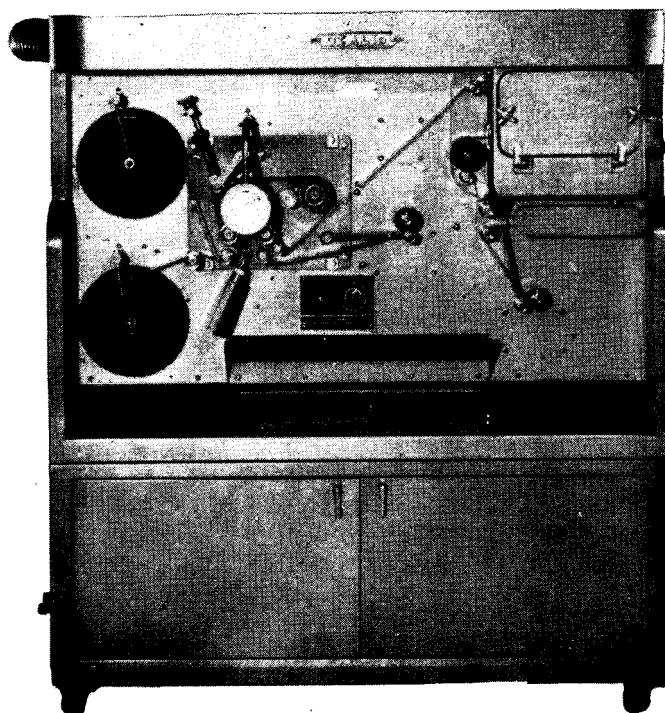
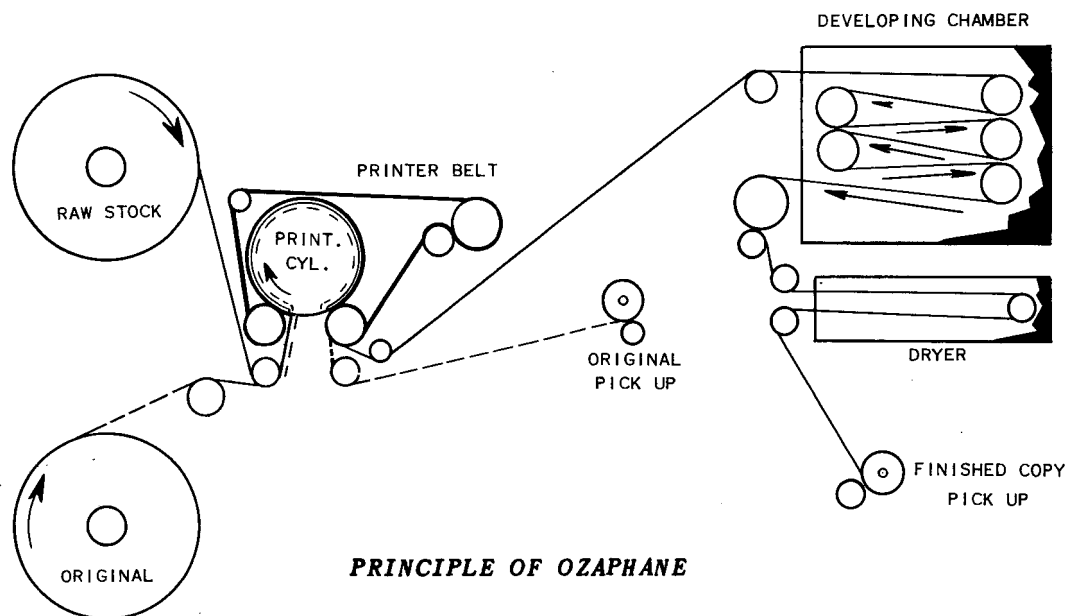
The ozaphane machine produces a duplicate film copy. If the original film is negative, the duplicated copy will be negative; if the original is positive, the duplicated copy will be positive. Also there is no capability for enlarging or reducing on this machine.

Its chief assets, however, are speed and economy. Frames are duplicated at a speed varying from fifty to two hundred frames per minute depending on density of the original film. The cost of duplicating film is approximately one cent per frame.

The ozaphane machine contacts the processed microfilm with unexposed raw film and makes the exposure with a high mercury vapor lamp. The raw stock is then run through a chamber containing ammonia fumes. The ammonia reacts chemically with the diazo dyes coupled in the film, and the image is formed. The film emerges from the chamber dry and ready for use. This film can be used three different ways: (1) in making paper prints, (2) in making another film copy, and (3) to be read on a microfilm reader (a simple enlarging device for projecting the image on glass). Ozaphane prints are permanent and are easily stored. The machine can handle rolls of film up to one thousand feet in length.

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Original : Roll Film
 Max. Film Size: 16 or 35 mm.
 Result : Duplicates on
 Film at Size
 Approx. Price : \$4518.00

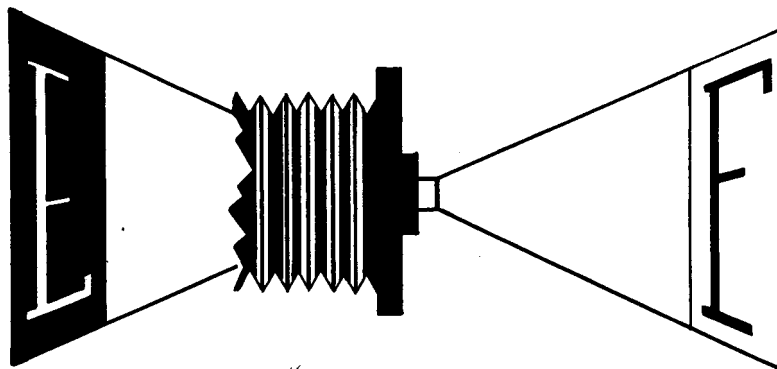
OZAPHANE

8 x 10 CAMERA

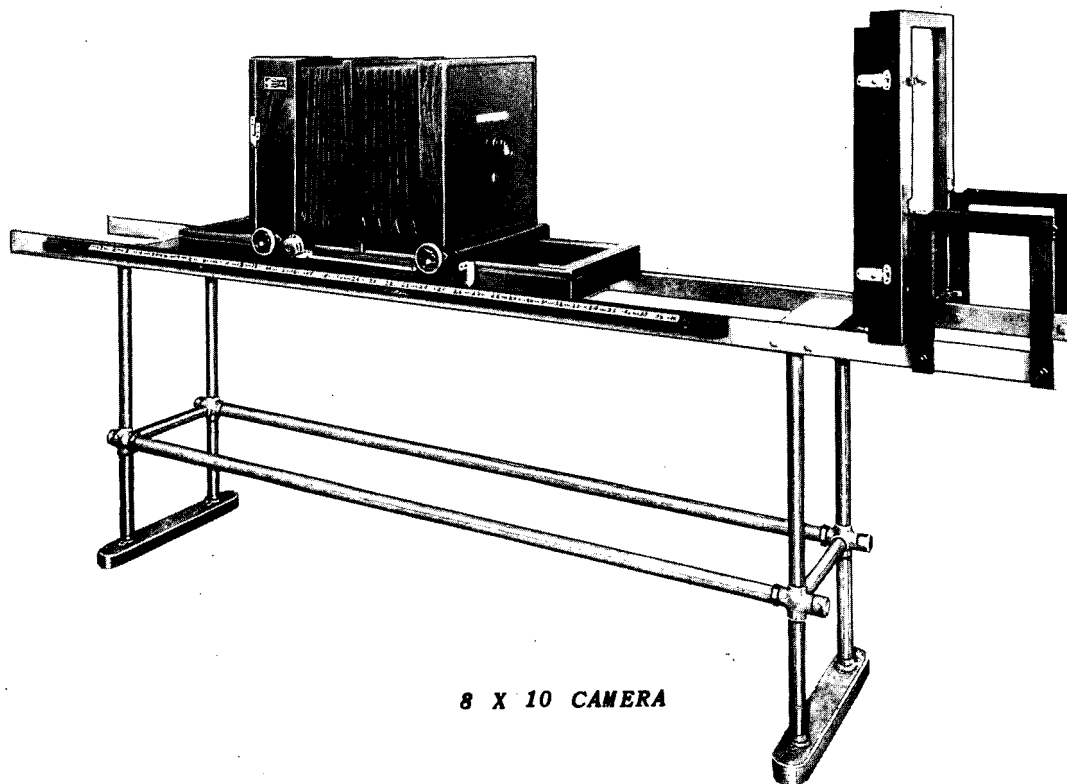
The 8 x 10 camera is similar to a microfilm camera except that it is much larger and utilizes cut sheets of film instead of roll film. Its use is particularly adaptable to copying large maps and similar material where color gradation and maximum detail must be maintained. In any photographic process where excessive reductions are made, a certain amount of detail is lost. The use of an 8 x 10 negative often eliminates the need for excessive reduction with the resultant retention of minute detail.

The camera produces a negative capable of projecting images on sheets as large as 40" x 60" when maps and charts are required in such sizes.

The 8 x 10 negative is processed similarly to other film. It is first developed in a developing bath, then goes into a short stop, followed by the hypo solution, and is finally washed thoroughly in water. However, it must be processed individually. This size negative does present somewhat of a storage problem because of its size.



PRINCIPLE OF AN 8 X 10 CAMERA



8 X 10 CAMERA

Original : Copy Submitted
Max. Orig. Size: Up to 41 x 48 in.
Result : Film Negative
Approx. Price : \$1324.00

OZALID

The ozalid process employs the same principle of diazo dyes and ammonia fumes as found in the ozaphane process. However, in the ozalid process, the diazo dyes are coupled in paper instead of film.

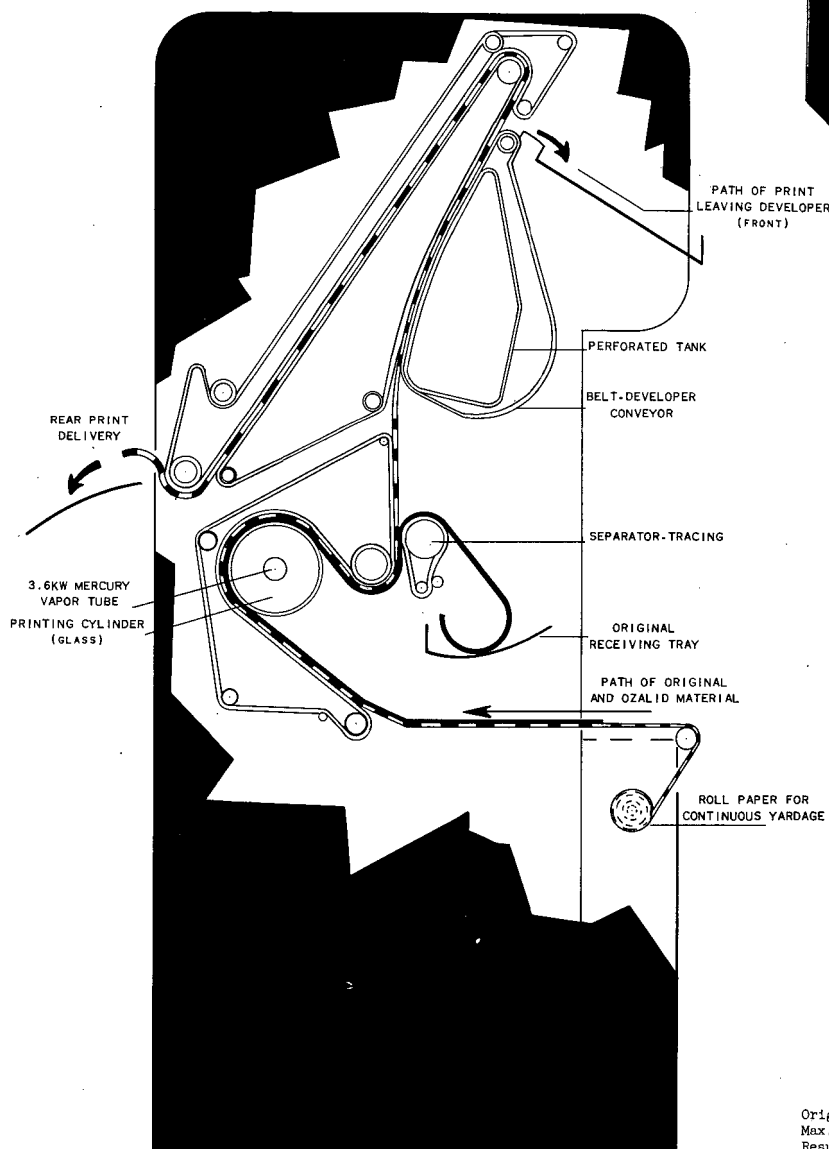
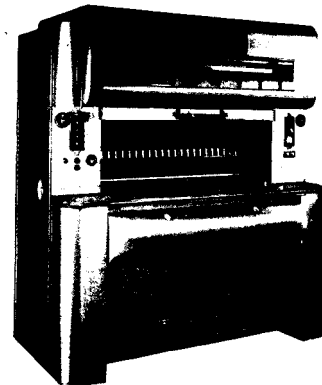
To make an ozalid print, the original is placed in contact with dye-coupled paper and fed into the machine where exposure is made by a high mercury lamp. The original and exposed paper are then separated, the original returned, and the exposed paper processing to an ammonia fumes chamber. Here a chemical reaction takes place and the image appears on the paper. The paper is expelled from the machine dry and ready to be used. The Printmaster ozalid machine is fast, capable of taking a roll of paper fifty-four inches wide and printing and developing at speeds up to thirty feet per minute.

The ozalid machine is a direct printer. If the original is positive, the copy will be positive; if negative, a negative copy will be produced. Also, the machine is not capable of making enlargements or reductions. It must also be remembered that when using the ozalid process the original must be transparent or translucent. Linen cloths, films, and foils are types of originals that produce the best results. Thin onion-skin paper may also be used as an original. Ozalid paper can be written upon easily and can be folded without difficulty.

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OZALID



PRINCIPLE OF OZALID

Original : TRANSLUCENT Copy
 Max. Orig. Size: Up to 59 in. Wide
 Result : Exact Duplication;
 i.e., Pos. to Pos.
 Neg. to Neg.
 No. Copies : Up to 25
 Approx. Price : \$5976.00

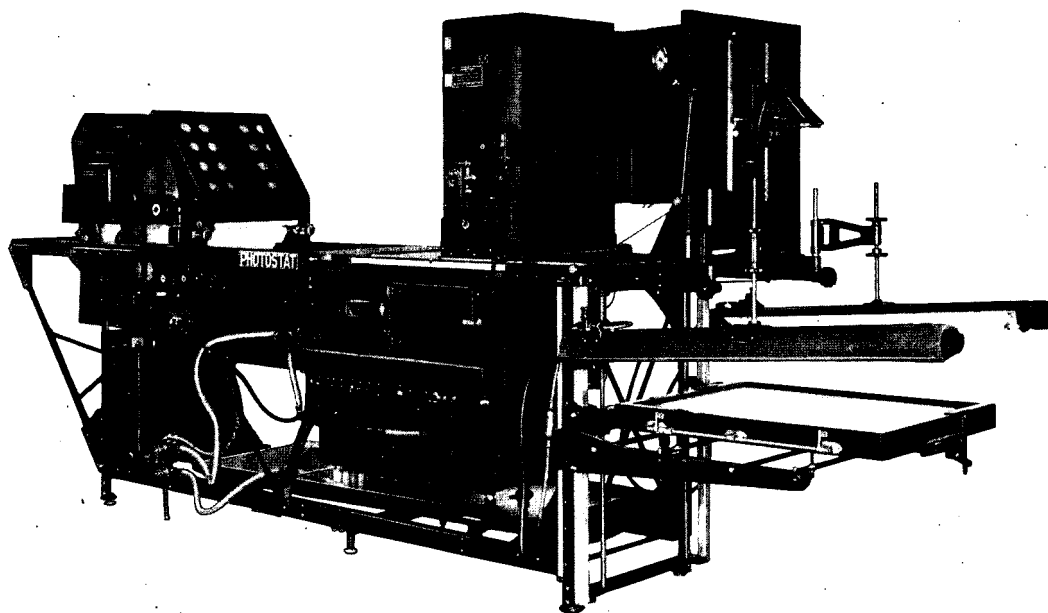
PHOTOSTAT

Photostat is a trade name but common usage has established it as a process of photo-copying on paper.

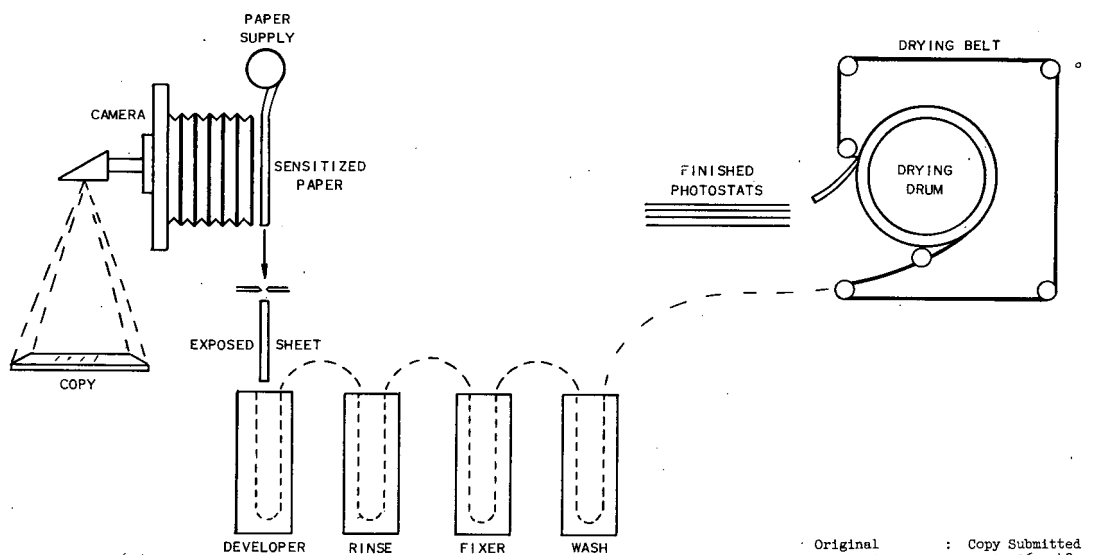
There are a number of different models of photostat machines ranging from the standard to the number four continuous models. Some machines just expose and develop the print; others automatically process the paper completely; and others are capable of complete processing on both sides of the paper. Reductions and enlargements are easily made.

The machine has a copy board; lens and prism; a paper holder; various developing, fixing, and washing baths; and a dryer, all in one unit. The paper holder accommodates a roll of paper eighteen inches by three hundred and fifty feet. When the original is exposed, the paper is wound down and cut off the roll. The maximum size sheet is eighteen by twenty-four inches. This sheet is then fastened to a continuous chain which travels the paper through a developing bath, a fixing bath, and a washing bath. The speed of the machine determines the developing, fixing, and washing times. Exposure time is determined manually. The chain ejects the paper to a drying drum. When the paper completes the cycle of the drum, it is ready for trimming and use. It takes approximately nine minutes for a print to process from beginning to end. However, since the machine is continuous, a new print can be started at intervals of approximately thirty-six seconds. The photostat produces a reverse print; i.e., if the original is positive (black on white), the print will be negative (white on black) and vice versa. Thus, for example, an order requesting the making of one negative and one positive print will consume virtually twice as much machine time as a request for two negatives, since the negative must be completely processed before it can be used in making the positive. The cost of producing a negative is the same as a positive since they are both paper and are processed exactly the same. Also, cost does not become relatively cheaper with high quantity since every copy has to be processed by identical steps.

The photostat machine is versatile since filters and various kinds of paper can be used to improve print quality.



PHOTOSTAT



PRINCIPLE OF PHOTOSTAT

Original : Copy Submitted
Max. Orig. Size : Up to 36 x 48 in.
Max. Enlargement : Up to 18 x 24 in.
Result : Paper Copy
No. Copies : Up to 25
Approx. Price : \$8305.00

MOTION-PICTURES

In the most modern up-to-date reproduction plants, facilities for duplicating motion-picture film will occasionally be found. This is not done with the idea of producing commercial "movies" since such a program is complex, technical, and can become very expensive. However, there is a demand for duplicating motion-picture film. Often requests are received to duplicate 16 mm., 35 mm., or enlarge 16 mm. to 35 mm., or to contact print 16 mm. and 35 mm. motion-picture film.

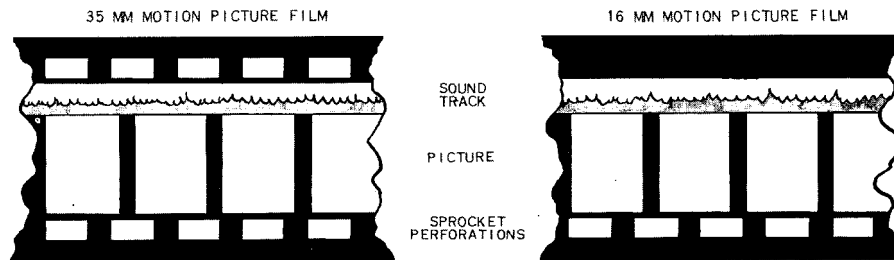
Since both 16 and 35 mm. motion-picture film and still film can be processed by the utilization of the same darkrooms, equipment, and in many instances the same personnel, the inclusion of motion-picture duplicating facilities in a reproduction plant is a logical step.

The Depue Optical Printer is one of the better motion-picture film duplicators. All film to be duplicated must be checked first for density variations. These variations are indicated by notches on the original film and are recorded on the calibration panel of the machine. When the film processes through the printer, the notched areas activate the calibration panel which automatically controls the light intensity and this compensates for density variations in the film. When duplicating exact size; i.e., 35 to 35 or 16 to 16 mm., the original film is contacted with the new film and exposed to the light unit. However, when duplicating enlarged or reduced sizes, the image on the original film is projected to the new film and exposed. The operation of the printer is such that the film is advanced one frame at a time when action is stopped, exposure made, and then advanced to the next frame. All this takes place so rapidly (the printer scans 46 feet of 35 mm. and 18 feet of 16 mm. per minute) that it seems continuous.

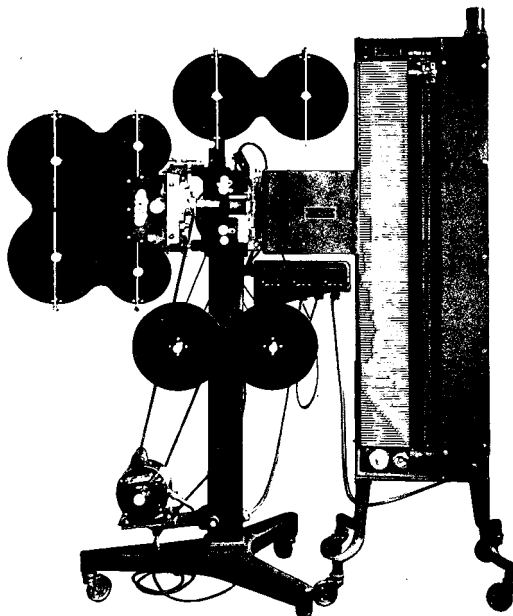
A sound printer is necessary to duplicate the sound track on motion-picture film. Most sound printers are built either for enlargement, reduction, or contact printing and, therefore, lack versatility of the optical printer. The basic operation of an enlarging or reducing printer is virtually the same. The raw stock (which may have been previously exposed by the optical printer) and the original film to be duplicated are fed into the printer simultaneously. The original film may be a sound track or it may be an actual motion-picture film containing both the image and sound track. In either case, the sound must be synchronized with the picture.

When duplicating and reducing a 35 mm. film to a 16 mm. film, the films proceed, behind a lens which automatically reduces the image and in front of the light which makes the exposure. The films are then rewound in the proper receptacles.

Both the optical printer and the sound printer are installed in darkrooms since all color and negative duplicating must be accomplished in total darkness. After the film has been exposed, it is usually processed in an automatic processor such as the Houston processor. When completely processed and dried, the film can be projected.



STRIPS OF MOTION PICTURE FILM



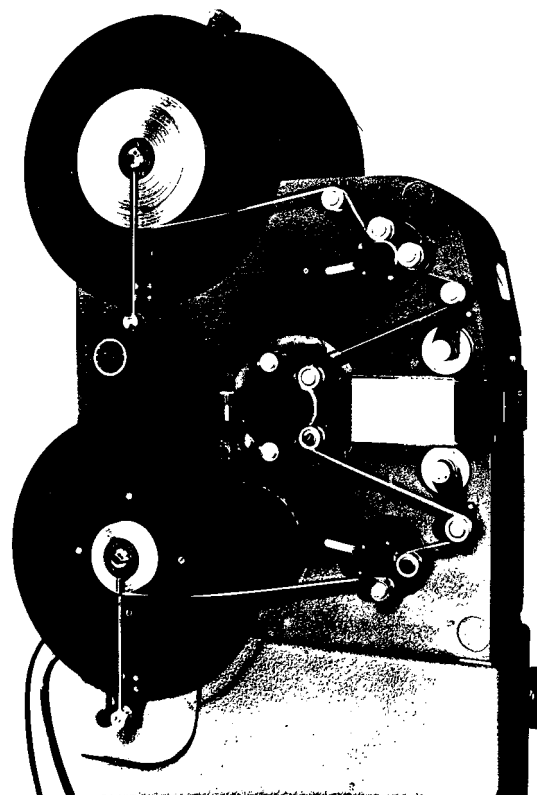
PICTURE PRINTER

Sound Printer

Original : Roll Film
 Max. Film Size: 16 or 35 mm.
 Result : Reduce Track from
 35 to 16 mm. only
 Approx. Price : \$9257.00

Picture Printer

Original : Roll Film
 Max. Film Size: 16 or 35 mm.
 Result : Duplication at Size
 Reduce 35 to 16 mm.
 Enlarge 16 to 35 mm.
 : Color or Black and White
 Approx. Price : \$7899.00



SOUND TRACK PRINTER

1. This is a sample of an ozalid print.
2. Number of copies ordinarily furnished: 1 to 25.
3. Type of work suited to process:
 - a. Text and tables
 - b. Drawings
4. Copy requirements: Original must be translucent.
5. Size limitation: 54 inches wide by X length, since paper comes in rolls.
6. Color limitation: Black and white or reverse is best. Other colors are obtainable depending on colored dyes impregnated in different paper.
7. Quality of results:
 - a. Depends on transparency of original - fair to very good.
 - b. Writing Surface - good.
8. Approximate machine processing speed: 5 to 10 feet per minute.
9. Approximate cost per 8 x 10 print: .04.

1. This is a sample of a photostat print (negative*).
2. Number of copies ordinarily furnished: 1 to 20.
3. Type of work suited to the process:
 - a. Text and tables.
 - b. Charts.
 - c. Drawings.
 - d. Reprints.
4. Copy requirement: Finished copy can be no better than the original.
5. Size limitation: Largest single sheet is 18 x 24 inches. Capable of enlarging and reducing.
6. Color limitations: Copies are black and white. Colors are held in gradations of gray.
7. Quality of results:

- a. Legibility - good to very good.
- b. Writing surface: poor.

8. Approximate machine processing speed: From exposure to completed print - 9 minutes. Additional copies every 34 seconds.
9. Approximate cost per print: .20.

* Lower half of print is a photostat positive.

Bindery Methods

All printing and reproduction plants must have access to bindery operations either within their own organization or closely allied thereto. The word "bindery" can cover a wide range of operations in the graphic arts. Operations from the simple collating and stapling of documents to the most elaborate sewing, gold stamping, and casing of books are termed bindery operations.

Some of the large bindery plants, specializing in binding of books, have large gathering machines, special sewing machines, gluing and pasting machines, presses and other special types of machinery used in the trade. In these plants, the cost of equipment alone can easily amount to hundreds of thousands of dollars.

The discussion of this equipment is not within the scope of this manual, since the equipment is so large and is not usually found in the average reproduction plant. Rather, it is our intention to discuss some of the more commonly used equipment found in the average reproduction plant that is known as finishing equipment. Such equipment as folding, collating, stapling machines, and drills are usually sufficient to give the final finishing touches to a document to make it presentable, usable, and sturdy.

Here, as in other sections of reproduction plants, equipment is designed to do a specific job. For example, there are many different makes of folding machines and also several different sizes of the same make. The manufacturer's idea, of course, is to provide a machine commensurate in size with any size of reproduction plant.

BINDERY

The up-to-date printing plant will "gang" run pages of magazines, documents, reports, etc. on the biggest press available, providing the quantities justify the existence of large equipment. Such practices are for speed and economy and especially saves manpower in the collating operation.

To take advantage of these labor-saving short cuts, the job must be planned correctly. The original layout must be such that when the sheet of paper is printed and folded, pagination will fall according to plan. Most folding machines of any size are capable of making both parallel and right-angle folds. The number of parallel and right-angle folds that can be made usually depends on the size of the folder. Folders usually have perforating and gluing attachments that make them versatile machines.

They are constructed with a friction or air-type feeder, various heads for folding, and a delivery receptacle. They are very accurate in their folding, yet a job will have a more professional look if after folding, it is put in a press to establish the fold more definitely. Documents and reports that have pages folded usually are trimmed on at least three sides. Large sheets that are folded to make smaller pages are known as signatures.

After the printed sheet is folded into signatures, the signatures are assembled in sequence. This assembling process is known as collating. A report folded into signatures may be collated either from the center of the signature or the signatures may be piled upon each other depending on the original layout. The first method of collating is utilized when a saddle-stapled book is preferred and the second when a side staple is requested. Often when a book is side stapled, tape is glued up the back to add strength and to cover the staples.

The peculiarities of a given job determine whether it can be collated by machine or whether it is best to collate it by hand. Most small collating equipment can manipulate only single sheets. However, some equipment will handle both single sheets and signatures. The Macey collator, although designed for single sheets, will handle four-page signatures. It has eight stations, each accommodating a stock of paper $11\frac{1}{2}$ inches high. Each sheet is separated from the next sheet by a blast of air, then grasped by a pair of rubber suction cups and carried to a conveyor tray. Automatic raising mechanisms keep the tops of the stock at the necessary height. A sensitive gauge checks the thickness of a completed set and stops the machine if any variation exists. The collator can be geared as slow as 700 sets per hour, or as fast as 4,000 sets per hour.

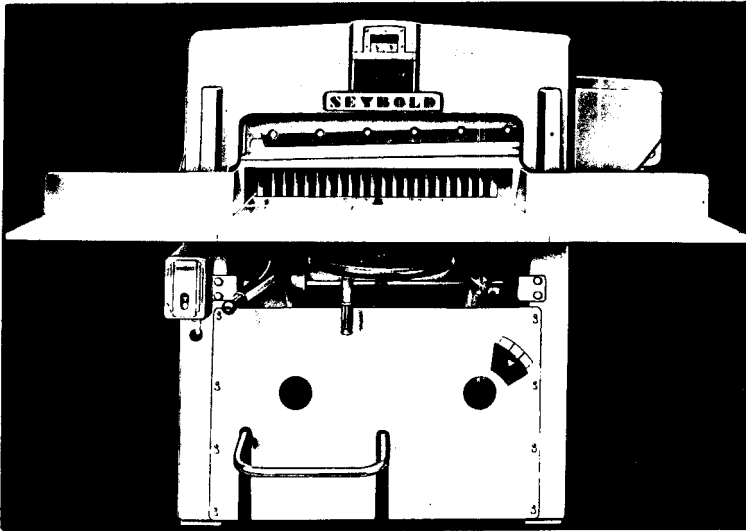
After a document has been collated, it must be fastened. This is usually accomplished by punching holes and fastening with Acco fasteners, Chicago screw posts, or loose-leaf binders; or by stapling with wire staples; or by sewing with a machine.

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There are a number of different makes of paper drills. There are those that have only a single drill and those much larger which have adjustable multiple drills. The Berry drill is an example of the latter type. The standard equipment is two heads, although as many as five may be operated successfully. It is equipped with an automatic table lift. Any kind of paper or any thickness of cardboard can be drilled on this machine. An extractor, operating on the inside of the cutter mechanism, removes the core from the stock making it impossible to clog the drill. It drills clean-cut holes any size from $\frac{5}{32}$ of an inch to $\frac{1}{2}$ inch through two inches of stock in one operation. Minimum spacing between holes is $1\frac{3}{4}$ inch and the maximum 18 inches.

When a more permanent binding is desired, the document will be stitched with a wire staple. Commercial suppliers of stitching machines usually carry a complete line of machines capable of stitching documents varying from a few sheets up to $2\frac{1}{2}$ inches in thickness. Small machines are built to handle stitches up to $\frac{1}{2}$ inch in thickness and heavy-duty machines stitch thicker documents up to $2\frac{1}{2}$ inches in thickness. Stitching speeds vary from 100 to 250 stitches per minute.

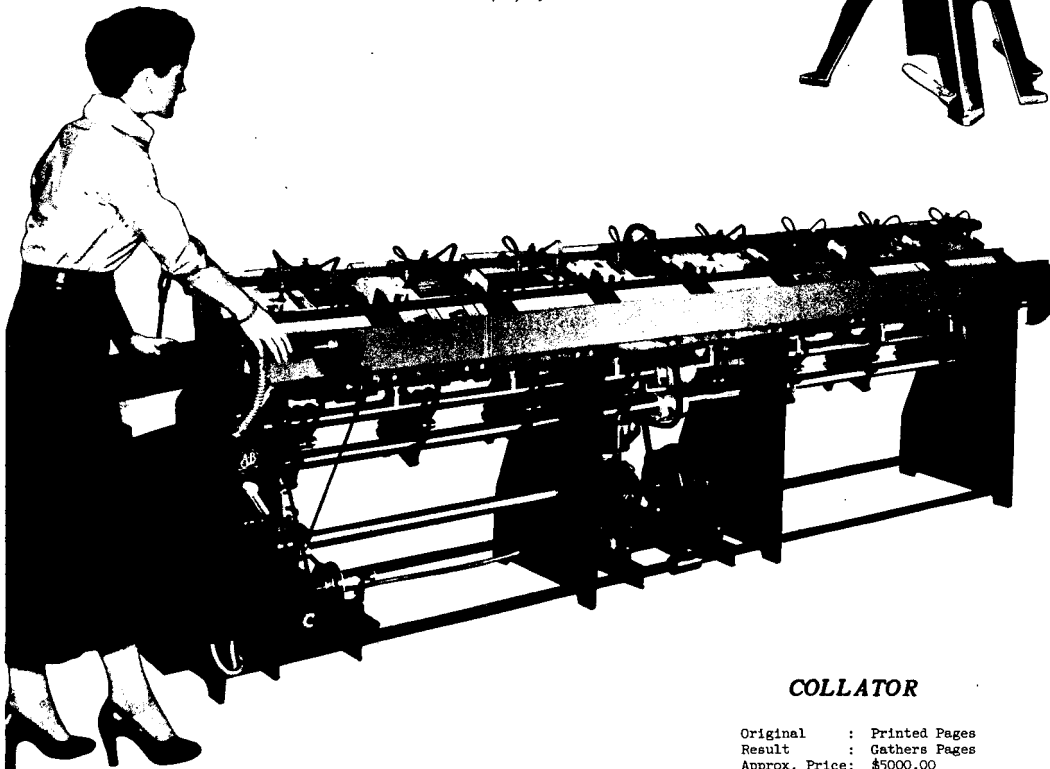
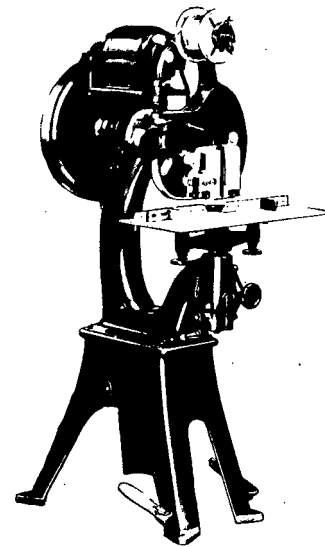


PAPER CUTTER

Original : Press Stock
Result : Printed Pages
Result : Trims Job to
Finished Size
Approx. Price: \$12,605.00

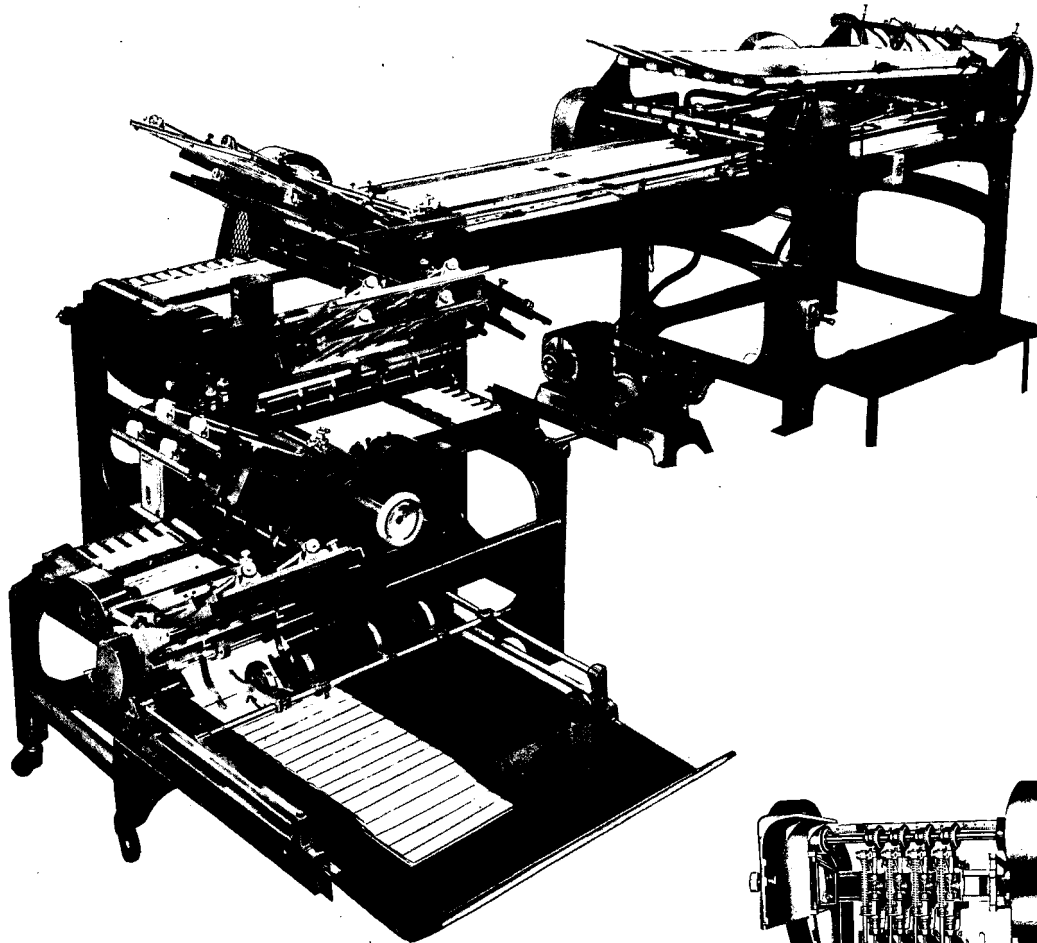
STITCHER

Original : Printed Pages
Result : Stitches Collated
Pages
Approx. Price: \$810.00



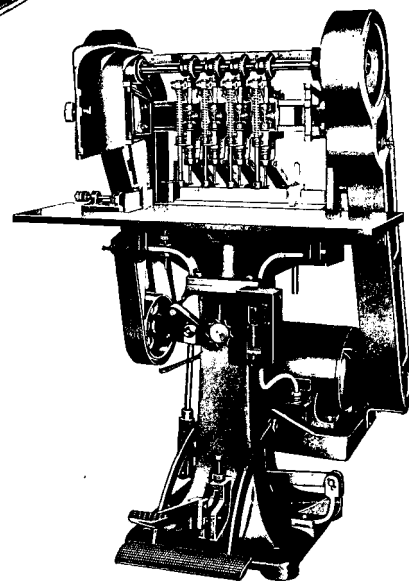
COLLATOR

Original : Printed Pages
Result : Gathers Pages
Approx. Price: \$5000.00



FOLDING MACHINE

Original : Printed Sheets
Result : Parallel or Right
Angle Folds to
Form Signatures
Approx. Price: \$6750.00



Original : Printed Pages
Result : Drills Holes
for Binding
Approx. Price: \$2124.00

DRILLING MACHINE

REPRODUCTION REQUISITION

NOTE: SEE INSTRUCTIONS ON REVERSE SIDE										REPRODUCTION REQUISITION										JOB NUMBER	
ORDERED BY (PERSON)					BUILDING					ROOM					PHONE					THIS DATE	
BRANCH OR OFFICE					DIVISION					SECTION					DATE JOB REQUIRED						
SERVICE REQUESTED		X	SIZE	NUMBER OF ORIGINALS	COPIES REQUIRED ON EACH	TOTAL NUMBER OF COPIES	PRINT	X	BINDERY	X	DISPOSITION OF NEGATIVES, PLATES, COPIES, ETC.	X									
PHOTOSTAT				NEG.			ONE SIDE		ASSEMBLED		RETURN										
				POS.			TWO SIDES		UNASSEMBLED		RETAIN										
PHOTOGRAPHY				NEG.			HEAD TO HEAD		PASTED		DESTROY										
				PRINTS			TUMBLE HEAD		PUNCHED												
MICROFILM				NEG.			PAPER		PADDED		ESTIMATED MONTHLY USAGE										
				PRINTS			KIND		COLOR		CLASSIFICATION										
OZALID							ADDRESS		PERFORATED												
							INK		NUMBER DATA	X											
COMPOSING							COLOR		NUMBER		TO BE RETURN										
									NOT TO BE RETURN												
OFFSET PRINT							REMARKS:														
MIMEDOGRAPH																					
ADVERTISINGGRAPH																					
DELIVERY RECEIPT																					
THE SERVICE ORDERED ON THIS REQUISITION RECEIVED																					
JUL 1959 36-2																					
SIGNATURE OF RECEIVING OFFICIAL												SIGNATURE OF REQUISITIONING OFFICIAL									

BLUE

PINK

WHITE SHEET

EXPLANATION:

Form No. 36-2 in triplicate should be forwarded with original material to the Printing and Reproduction Division when requesting reproduction services.

After being given a job number the blue copy will be returned, indicating the date of its receipt and the scheduled completion date of the job.

Determine definitely what is wanted before sending copy for reproduction and thereby alleviate expensive rebuilding of forms and remaking formats.

Reference should always be made by job number when inquiring about the work.

Name, building, room, phone, etc. appearing at the top of requisition should be that of the person most familiar with the job. Signature of requisitioning official should be as prescribed in Agency Regulation

HOW TO CHOOSE THE RIGHT PRINTING PROCESS

When there are photographs or other half-tones

